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HIFI NEWS

NOVEMBER, 1974

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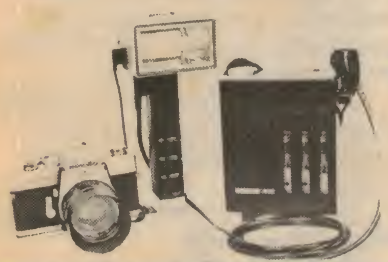
ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine VOLUME 36 No 8



"Computer" flashguns have been around for a few years now, but the latest types have overcome the energy wastage problems of the earlier models. How they do this is explained in the story on the Mecablitz 402, beginning on page 32.

FM is almost here — so how does one go about obtaining an FM tuner? You can buy one — or you can build one yourself, such as the Heathkit AJ-1214 above. See our article on FM tuners — page 40.

PROJECT COMPETITION . . . THE WINNERS

Next month we will be announcing the winners of the Practical Project Competition announced in our May issue. We will also begin publication of selected entries, which have come to hand from all over Australia and New Zealand — entries which should provide a constant flow of new ideas for many months to come. There are three major prizes but there is a good chance that other entries will earn, for their authors, a very useful publication fee.

On the cover

The girl is holding a metal glaze resistor made at the Kingsgrove (NSW) plant of IRH Components Pty Ltd. IRH are very proud of their new metal glaze resistor facility, which they feel can compete economically and technically with any in the world. Read about the IRH success story, beginning on page 26.

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world of electronics and hi-fi

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Editorial Viewpoint

Second thoughts on "board bashing"

Because of their very function, regulatory bodies like the Australian Broadcasting Control Board are always rather less than universally popular within their sphere of control. Whatever the decisions they make and implement, there are always some who believe them to be wrong. This is no doubt a fact of life to which all past and present members of the ABCB must have reconciled themselves.

While some criticism is thus probably inevitable, it still seems to me that over the last couple of years the board has reaped rather more than its usual share. In fact "board-bashing" seems to have become a popular pastime, with Cabinet ministers leading the way, lobby groups following close behind, and others hurling the occasional brickbat for good measure.

I'm not saying that the board is beyond criticism — by no means. Its members are human, and can err. Their decisions and actions involve a vital public resource, and should therefore be open to public scrutiny.

No, what I think we all tend to forget at times is that the ABCB has a very difficult job to do, with constraints imposed from many sources, and implications not just for the present but for the future as well. It is all too easy to blame them unjustly, by overlooking an important constraint or implication.

What prompted these comments was the arrival a few days ago of an enormous telegram from the ABCB, giving details of the colour TV test program times and formats which are to be permitted during the months leading up to C-day. The telegram was the largest I have ever seen, no less than 1.3 metres long, and about 104 lines!

After wading through all of the "shalls" and "shall nots" of the telegram, my first reaction was understandable. Here, it seemed, I was confronted by the ultimate in bureaucratic obstructionism, carefully worked out so that whatever colour material the stations could transmit, virtually no one would be able to enjoy it.

Yet it didn't take long to realise that this reaction was both hasty and unreasonable. After all, it was the industry itself — particularly the stations and the receiver manufacturers — which had originally pressured for a uniform starting date timed to allow them to make their preparations. The ABCB has done little more than implement what was asked, modifying the details in response to later pressures.

If the result seems somewhat Gilbertian, this is scarcely the sole responsibility of the board.

— Jamieson Rowe

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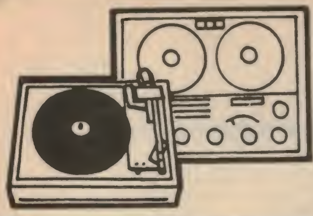


Hi Fi News

More meaningful loudspeaker curves?

Response curves for loudspeaker systems are a dime a dozen, and all of them open to arguments of one kind and another. Well, here's a new slant: Maybe conventional curves represent one thing to the critical eye but quite another to the critical ear!

by NEVILLE WILLIAMS

Amongst the many questions which arise when evaluating loudspeakers are two which come to the fore quite regularly.

One has to do with the physical size of loudspeaker systems. At one time it was commonly assumed that no system could give a good account of itself at the bass end unless it encompassed an internal volume of at least six cubic feet. If it could be nine cubic feet and built from brick, so much the better! Small enclosures were fit only to sneer at!

But sheer necessity has now forced most enthusiasts into using smaller enclosures, often in the range 1 to 2 cubic feet. Surprisingly, many of them manage to sound rather good. To be sure, various tricks have been pulled in their design but, against a background of tradition mixed with physics, there is still an element of surprise that so much can emerge from so little!

Why?

The second point has to do with the marked difference in the general sound and "colouration" of loudspeaker systems which, superficially, would appear to have quite similar response curves. How is it that two or three decibels here and there can make a profound difference between a system that is "middly" and one that is just the reverse?

Well, a writer in "HiFi News and Record Review", B. Greener, makes some interesting observations which could cast light on both of these seemingly anomalous situations.

Greener points out that we normally plot loudspeaker response curves on an acoustic output basis, against a decibel scale. Having done so, we proceed to examine the curves visually, against a broad impression that 3dB is some kind of reference. A divergence of less than 3dB won't make any significant difference; a divergence greater than 3dB is worth a second look, no matter where it occurs.

Examination of typical curves may suggest that the difference between the bass-end performance of two systems is at least as noticeable as differences in the middle and / or upper register. But, as often as not, it's the other way round in terms of sound. In the course of an A-B test, attention focusses on the upper middle "colouration".

What we tend to forget is that the ear does not "look at" a power curve plotted in decibels. It is aware only of loudness, which is a subjective reaction and which is highly dependent on frequency. Greener resorts to the "Stevens equal loudness contours" to show that, for a constant power signal of 96dB, the subjective loudness expressed in Sones increases from below 20 at 30Hz to a peak of more than 100 at 9000Hz.

A family of such curves shows that a spread of +5dB in power represents only about the same spread in Sones at 30Hz. At 1000Hz the spread has increased to about 40 Sones, and to 80 at 9kHz. Nor are the contours symmetrical; they tend to emphasise rising power (peaks) more than falling power (troughs).

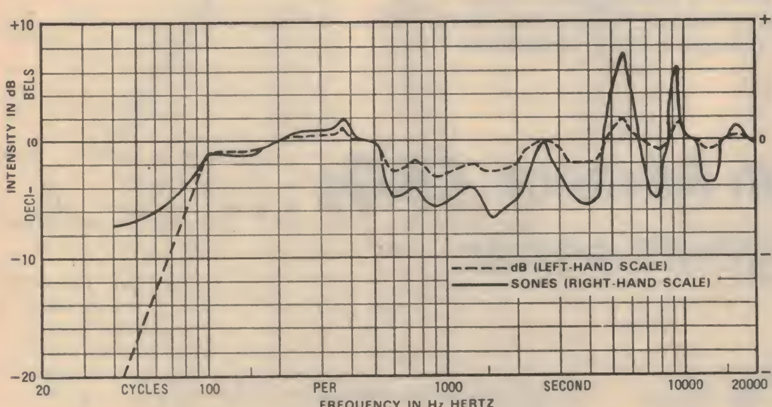
The implication is obvious: Differences of 5dB around reference produce a minimal subjective awareness at very low frequencies. The awareness increases with rising frequency, reaching maximum at around 9kHz — a figure which will vary somewhat from individual to individual. Furthermore, in the middle and upper register in particular, peaks will be rather more significant in their subjective effect than troughs.

Using the Stevens equal loudness contours, it is possible to re-draw typical loudspeaker response curves so that the measured power response in Decibels is translated into a likely subjective loudness in Sones. This will show up the increased significance of troughs and particularly peaks over the middle and upper register. It will also remove emphasis from a downward tapering bass response. (See typical curve).

Decca's new record brush has bristles so fine that, according to the manufacturers, over 1000 of them are involved in removing dust from each single groove. And, being electrically conductive, the bristles also dispel static charges, without resource to fluids. Recommended price of the brush is $12.95 through record and hifi dealers. Information from British Merchandising Pty Ltd, 29 York St, Sydney 2000.

Greener stresses that conversion of the curves to Sones will not add or subtract peaks and troughs or obviate contours. What it will do is to modify their amplitude, depending on their frequency and their position relative to the zero reference line. Visually, the re-drawn curve should be more closely related to the loudness which is likely to be perceived.

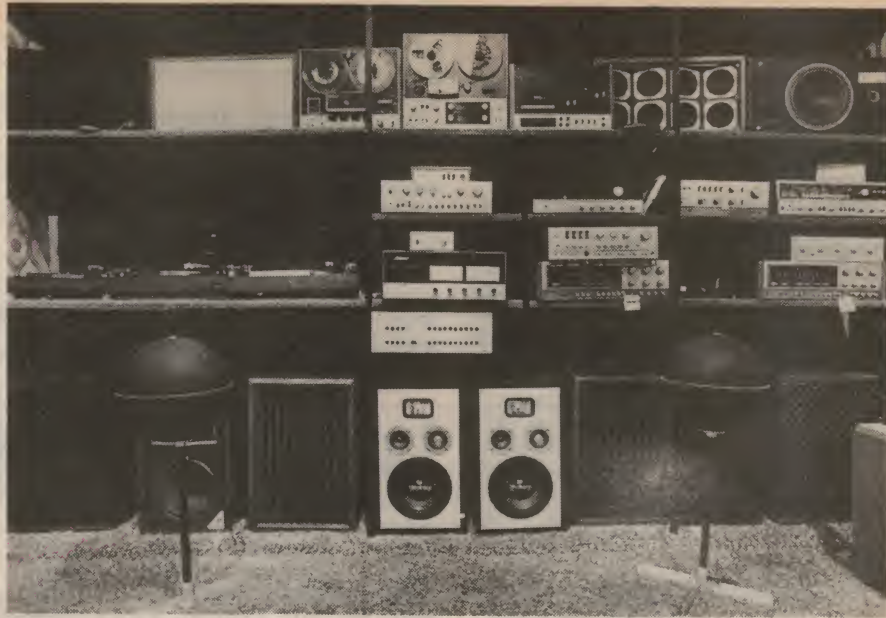
It so happens that the result fits in nicely with subjective reactions referred to at the outset. When the loudness curves of a typical consumer bookshelf system and a monitor system are compared, the differences up to 1000Hz are not all that great. But, above 1000Hz and particularly in the region 4-10kHz, the differences are visually far more obvious in Sones than they are in Decibels. Peaks, troughs and contours become visually much more arresting and



Judged on the ordinary decibel response curve shown dotted, this typical bookshelf loudspeaker might be considered fairly good at the top end, though noticeably lacking in bass. Replotted in terms of subjective loudness (solid curve) the bass-end deficiency is depicted as much less significant but attention is drawn to the peaks and troughs in the upper register which could produce obvious colouration.

APOLLO HIFI CENTRE

New demonstration room



Apollo Hifi Centre, of 283 Victoria Rd, Marrickville, NSW, have recently opened a completely new sound demonstration showroom. Of much the same proportions as an average listening room, it is quiet and air conditioned for relaxed listening. A representative array of equipment is installed, ready wired for A-B comparison tests. An unusual feature is a pair of Bose multidirectional systems suspended from the ceiling to provide a comparison with a highly diffused type of system.

it is not surprising that they might account for audible colouration.

Greener admits that peaks and troughs, in other sections of a total amplifier system would have a comparable subjective effect but he rejects the idea of plotting their response in Sones on two grounds, one philosophical, the other practical:

Philosophical: Other units in the system feed devices and it is reasonable to record their performance on a purely electrical basis. Loudspeaker systems feed into human ears and it is appropriate at this point to introduce the subjective factor.

Practical: High quality signal sources and amplifiers are relatively uniform and smooth in their response and it is not difficult to make small necessary allowances for amplitude divergence. It is in the loudspeaker system that the major discrepancies occurr and it is here that every effort should be made to relate those discrepancies to subjective reaction.

There would be problems, of course. For curves to be compared directly, it would be necessary for them to be presented for some standard loudness level which, logically, would have to be "comfortable" one for an average listener and an average loudspeaker system. The HiFi industry, worldwide, would have to reach agreement on the level and the method of deriving the curves in terms of approach and equipment.

This may be too much to expect.

Perhaps the most important spin-off from Greener's proposition may be to induce us to interpret more appropriately the conventional Decibel response curves; to be less sensitive to discrepancies at the bass end and progressively more aware of the middle and upper register — beginning at 500Hz and "peaking" subjectively at 9kHz.

This is different from simply expanding the dB scale, either mentally or phycically. To be sure, it would make the peaks and troughs more evident but it would do so at all frequencies, which is not what we want.

Lectures by Shure/Audio Engineers

Recently, Audio Engineers Pty Ltd played host in several of the capital cities to groups of hifi dealers, radio and TV station engineers and the technical press. Chief speaker at all the gatherings was Ken Reichel of Shure Bros Inc, of Illinois, USA. Purpose of his visit was to talk about Shure pickup cartridges and to demonstrate the current range of Shure microphones.

The microphones exhibited ranged from models in the $30-40 bracket (P.A., advanced amateurs, &c) to specialised professional models including an electret capacitor unit with in-built line amplifier and automatic noise gating.

For many, however, interest centred in what Ken Reichel had to say about pickup cartridge design.

"And thank you very very much for the jewels in the chest of drawers, the money in the safe and the excellent sausage in the fridge!" (BASF "Newsletter")

As is well known, Shure have been well up with the industry leaders on researching what they have chosen to call "trackability" — the ability of a cartridge to track the records now being produced, with a minimum of playing weight and a minimum of record wear.

He stressed that it is of no use merely having a low tracking force if the stylus "rattles" in the groove in the presence of high amplitude signals. Not only does this produce high distortion but it also causes increased record wear.

Conversely, there is little point in increasing the cartridge playing weight to enable it to track all records if this results in excessive stylus forces. This will also result in increased groove and stylus wear. It is particularly questionable logic to recommend an elliptical stylus, for the sake of its improved "tracing" ability of the constricted inner grooves, if it has to be used with a playing weight of more than 2 grams. A high rate of wear is inevitable in these circumstances.

The art of cartridge design centres on reducing effective tip mass and increasing compliance to the point where the cartridge will track all the records which an enthusiast wants to play at the lightest possible playing weight — by inference a gram or less. This, of course, must be combined with appropriate physical shape, dimensions, and reliability under expected playing conditions.

Continuing research has produced a quite notable increase in trackability, allowing cartridges substantially to keep pace with what all but the most reckless recordists are putting into the grooves. It is notable, however, that progress has slowed as performance has approached what seems currently to be close to optimum. Thus the

latest Shure V15 cartridge represents a smaller improvement step on its immediate predecessor, than was the case further back along the line.

Asked whether the latest Shure "quality" cartridge was suitable for professional use in radio and TV stations, Ken Reichel was less than enthusiastic. Whereas a hifi enthusiast tends to treat his cartridge with the greatest possible deference, disc jockeys, under pressure have no time for finesse. The cartridge, as a whole, has to "take it". And, if that means a stouter stylus and stiffer suspension, and a playing weight of 3½ grams to maintain trackability, so be it. Records can be replaced if they have to be!

What is more, the stylus shape and tracking angle has to be determined, not just on geometric ideals, but also on the need to stay in the groove when the record is rotated backwards in the act of cueing!

What arm does Shure recommend for its V-15 cartridge? Ken Reichel chose to not commit himself on this. There were quite a few arms to choose from which would do the job. The important thing, really, was to mate a good quality cartridge only with a good quality arm on the assumption — and in the hope — that the arm/suspension resonance would fall somewhere around 10Hz, being below the audio range and above the zone affected by record swing, footsteps, &c.

What about bias compensation on the arm? On this subject Ken Reichel became more expansive.

He explained that the drag on the stylus in any offset arm, acting against the base pivot, tends to pull the arm towards the centre of the record. This means that the tracking force against the innner face of the groove was greater than that against the outer face. The forces involved vary with the nature of the stylus, the tracking weight, the character of the record material and the groove speed of the particular track.

Since the inward thrust will vary with records and from outside to inside, it is difficult to compensate continuously and accurately. However, any compromise should favour the inner grooves for two reasons: (1) wavelengths are shortest and tracing problems greatest and (2) musical climaxes tend to occur at the ends of records.

Despite the fact the early Shure test records had a plain non-grooved section for bias adjustment, he felt that there was no particular relevance in observing the behaviour of a stylus on a plain surface. The drag was quite different from the same stylus resting in a V-groove.

The best way of optimising anti-skating bias was to play the inner grooves of a heavily recorded disc and reduce the playing weight until mis-tracing was just evident. Listen to the two channels separately and vary the bias until the amount of distortion seemed about the same. Gradually increase the playing weight and fiddle the bias adjustment until both channels were clean. This should be adequate unless another record turns up which requires a further slight increase in playing weight and anti-skate bias.

Some record players have the anti-skating bias adjustment calibrated in relation to the playing weight and the type of stylus. This was usually on the basis of setting the skating bias at about 20pc of the playing weight — not bad as a general guide but not as good as a systematic adjustment as a systematic adjustment as suggested earlier.

During the lecture, the subject came up of Shure's approach to cartridges compatible with normal stereo records and CD-4 quadraphonic discs. Did the Company's attitude still align with the "thumbs down" verdict of Shure Vice President James H. Kogen, published a few months ago?

Ken Reichel said that it did, despite the expenditure of very large sums on research. What is more, the Company's attitude had been reinforced by the fact that certain other prestige cartridge manufacturers had withdrawn their "compatible" products after a disappointing result.

He explained that it was possible to design a compatible cartridge that would work, by "forcing" the mechanics and particularly the playing weight. But, in his words, the technology seen by the ordinary stereo disc was the technology of ten years back.

"In our opinion, it isn't right to sacrifice ten years of development and refinement for the privilege of using the same cartridge on CD-4 discs".

A whole new approach would be needed to perform the dual role without sacrifice to present standards and this was clearly going to involve continuing and expensive research.

Lawrence & Hanson market Dynatron

Lawrence & Hanson Pty Ltd, of 142 Dorcas St, Sth Melbourne 3205 advise that they will be handling the very extensive range of high fidelity products, manufactured by Dynatron Radio Ltd, of Maidenhead, Berkshire, England. A most impressive colour booklet supplied to E.A. indicates the company's expertise in styling, with presentations which range all the way from metal frame and lacquer, through Swedish teak styling to Regency and Queen Anne, then on to American Gunchest!

Mr L. G. Johnstone, National Manager Electronics, of Lawrence & Hansen Pty Ltd, says that his company has felt for some time that that "there is a demand on the Australian market for a furniture concept Hi Fi equipment."

He continues: "Examination of the Dynatron range will show that not only fine quality furniture concepts have been met, but that both the contemporary white / black and walnut needs are catered for in the audio separates."

Trade inquiries may be made through any of the 80 branches of Lawrence and Hanson throughout Australia but actual sales will be through Capital City branches only. A complete stock of the Dynatron range is available in Australia. This includes amplifiers and tuner / amplifiers, free standing or in a selection of cabinets; contemporary equipment racks; equipment cum storage cabinets; record players, cassette players, loudspeaker systems in contemporary, conventional or period style; stereo headphones.

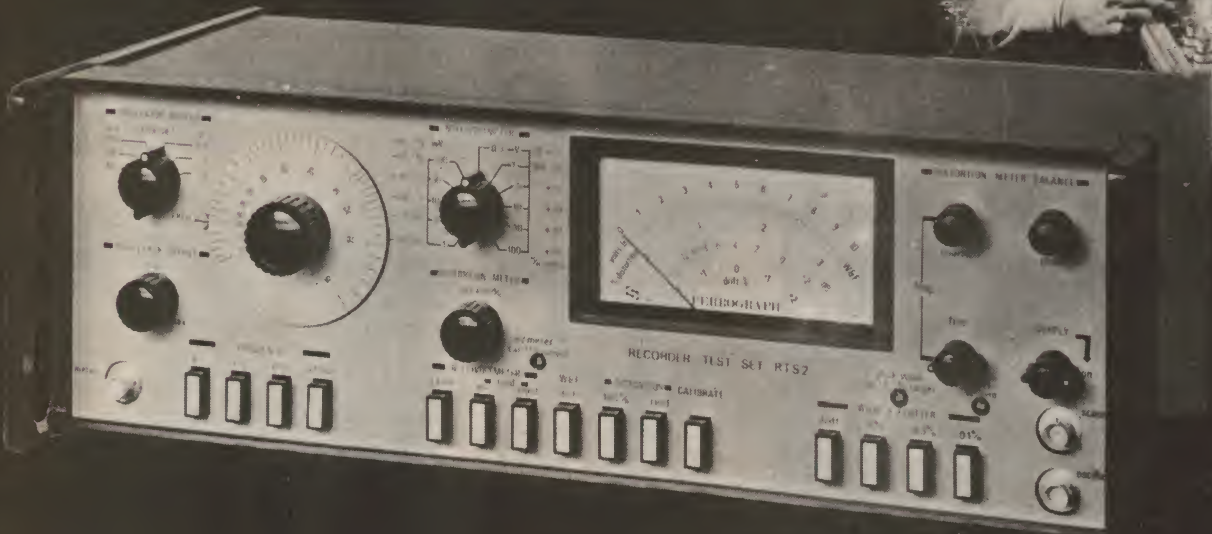
The Queen Anne style "Hambleden" suite by Dynatron houses a 15W per channel stereo amplifier with "surround" facilities, AM / SW / FM stereo radio tuner, belt-drive record player and Shure magnetic cartridge. Timber grain is burr walnut.

At the other extreme of the Dynatron range is the contemporary style "Carnival" system at left, finished in metal, lacquer, and grey acrylic plastic. For those with more conservative tastes, a similar system is available with teak rather than lacquer finish.

The systems incorporate a 15W solid-state stereo amplifier, with filters, and slide control of the main functions. Headphone facilities are standard.

FERROGRAPH RTS2

The complete audio test unit



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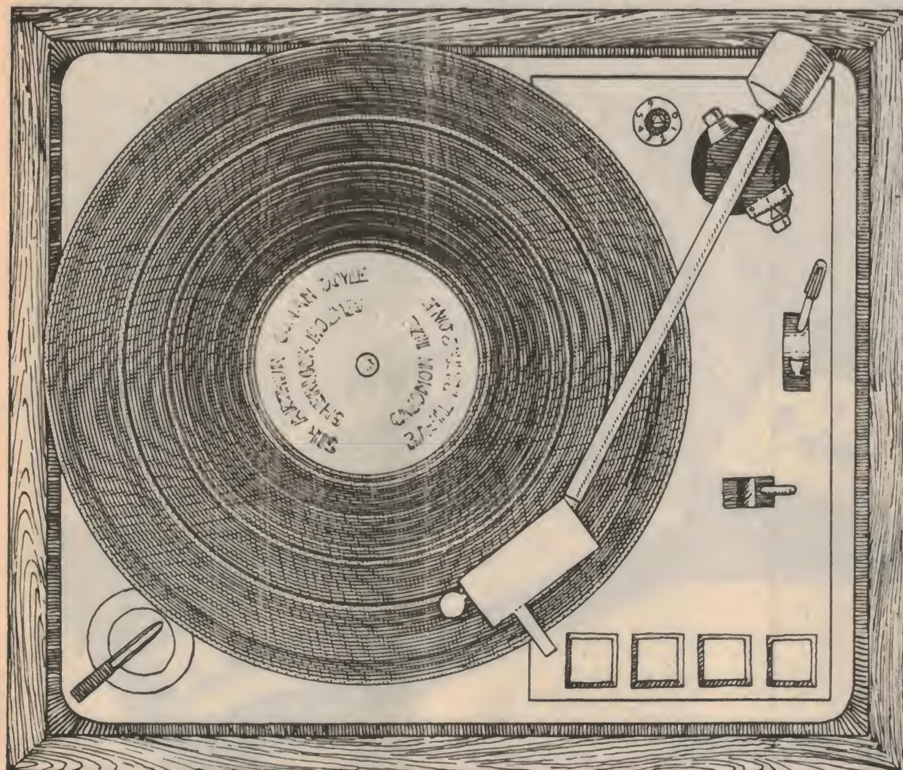

Julian Hirsch supplies the technical whys and wherefores, and Associate Technical Editor Ralph Hodges adds a gloss of buying guidance.

The job a record player has to do appears to be so simple that one might wonder why it merits such special technological and design effort from equipment engineers.

All the turntable need do is quietly rotate a record at a constant speed, usually 33 1/3 or 45rpm. The tone arm's job is simply to support a cartridge in a given geometric relationship to the record surface in such a way that the stylus exerts constant (and equal) force on the two walls of the V-shaped record groove as it is carried toward the centre of the record.

If these basic requirements could be met as easily as they are stated, selecting a record player would be no problem at all. As you might expect, things are not quite that simple. Although no record player can be said to perform its function with absolute perfection, in practical terms many of them are more than adequate for their assigned task. Nonetheless, each manufacturer goes to considerable expense to convince potential customers that his product offers unique advantages.

To make an effective buying judgment, it is helpful to understand exactly what is required of a record player, in what ways actual units may fall short of meeting these requirements, and the practical significance of the design and operating features of competing models.

Julian Hirsch, of the Hirsch-Houck Laboratory is a well known writer on hifi topics. This article is reprinted from the July 1974 issue of "Stereo Review" magazine.

THE PLATTER

The record is supported and turned by a platter, which is usually fitted with a rubber or plastic mat. Many mats contact the underside of a record over only a small area, through one or more raised ridges. Since it is necessary to support a record only at or near its circumference, some mats simply have three raised circles, for 7-, 10-, and 12-inch records, on the mat's surface. The less contact area the less the likelihood of transferring dust and other foreign particles from the mat to the record.

The platter should, of course be flat (and so should the record, but that is another story). Any vertical "wobble" in the rotating platter will not only impair cartridge tracking, but may introduce a "wow" even if the record is flat and is played at a constant speed.

A good platter is precision machined from a casting, usually of a magnesium or aluminum alloy, and is carefully affixed to whatever type of bearing assembly is employed. Sometimes the platter is made in two sections: a smaller inner hub that is driven (directly or otherwise) by the motor, and a larger outer ring which supports the record near the circumference and adds mass to the rotating system.

Although many people associate a high-mass turntable platter with low rumble and flutter, there is no necessary relationship between these factors. A relatively light platter driven by a small motor can have the same speed constancy (freedom from wow and flutter) as a heavier platter driven by a large motor. However, in general, the more expensive record players do have heavier platters.

Low-price record changers frequently use a stamped or drawn platter, which is lighter, has looser dimensional tolerances, and is less costly to manufacture than a machined casting. Some of these units may be quite satisfactory for a moderately priced music system, but they cannot be expected to match the more expensive players in freedom from rumble and flutter.

Today, almost all turntable platters are nonferrous, with only the cheapest being made from steel. Some phono cartridges have an appreciable external magnetic field, and this can cause an unexpected increase in vertical tracking force when a record is played on a steel turntable. On the

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Dolbyized Stereo Cassette Deck with Ferrite and Ferrite Heads for unrivalled recording and playback. Features include: Limiter recording system, Dolby Noise Reduction*, automatic full mode shut-off mechanism; tape selector switch. **System:** 4 track 2-channel stereo recording and playback; **Power requirements:** 240V AC, 50Hz, 10W; **Frequency response:** Cr02 30Hz-17KHz, Normal 30Hz-15KHz S/N ratio: Dolby off: 49dB; **Flutter and wow:** less than 0.2%; **Harmonic distortion:** 2.5%. **Inputs:** Microphone −72dB (0.2mV) low impedance, Line −22dB (0.06V) 680K ohms, Rec/PB 3.3K ohms. **Dimensions** 412 (W) x 115 (H) x 223mm (D). Weight: 5.3Kg.

**The word Dolby is a trademark of Dolby Laboratories, Inc.*

TC131SD
A quality Dolbyized deck at a sensible price. Features include: Dolby Noise Reduction*, Ferrite and Ferrite heads, complete automatic shut off, high performance limiter recording, Cr02 or normal cassettes, direct-coupling circuit for the heads, locking pause control. **System:** 4 track, 2-channel stereo recording and playback. **Harmonic distortion:** 2.5%. **Power requirements:** 240V AC, 50 Hz. **Frequency response:** Cr02 40Hz-15KHz, Normal 40Hz-13KHz. S/N ratio: Dolby off: 48dB. **Flutter and wow:** less than 0.22%. **Inputs:** microphone (−72dB, 0.2mV sensitivity, low impedance); line (−22dB, 0.6V sensitivity, 100K ohm impedance or more); Rec/PB (10K ohms or less). **Outputs:** Line: 0dB (0.775V) 10K ohms or more; Headphone: −28dB, 8 ohms; Rec/PB 50K ohms; **Dimensions:** 388 (W) x 95 (H) x 230mm (D); Weight: 4.5Kg.

SONY®
for particular people

TC131/TC134

other hand, the inexpensive magnetic and ceramic cartridges generally used with budget-price players will not usually interact with a steel platter.

• ADVICE TO BUYERS: The platters (or outer platter rings) of many turntables can be removed quite easily for inspection. This will enable you to judge the weight, if that is of special concern to you. Evidence that the platter has been rotationally balanced is often visible on the underside, in the form of little metal weights or asymmetrically drilled or punched holes. A practised eye should also be able to discern whether the platter has been cast, drawn, or stamped. But usually it's not easy to tell much about how well a turntable will perform from its platter.

THE MOTOR

Several types of motors are in common use for turntables, including four-pole induction motors, hysteresis-synchronous motors, permanent-magnet synchronous motors, synchronous/induction motors, and servo-controlled DC and AC motors. Hall-effect motors could be considered a subcategory of the servo motor. A synchronous motor operates at a constant speed over a wide range of line voltages and reasonable load variations. This does not assure that the record will turn at the correct speed, but merely that the speed will not change. Mechanical tolerances in the drive system can introduce a constant speed error, although this is usually negligibly small.

The speed of induction motors can be affected by power-line frequency and load changes and to a lesser degree by line voltage. However, these motors have good torque characteristics and are relatively inexpensive, making them the most popular choice in medium-price record players. The four-pole induction motor (operating from the 50Hz AC line) turns at just about 1,500 rpm. A number of high-quality automatic turntables (that is, record changers of "high-fidelity" calibre) use induction/synchronous motors combining the starting and operating torque characteristics of the induction motor with the speed constancy of the synchronous motor.

"Rumble" is noise of very low frequency that is generated by mechanical vibration within the record player. When picked up by the phono cartridge and sent on to the amplifier, it can emerge (through speakers with bass response adequate to reproduce it) as a deep, low-hum accompaniment to any record played on the system.

The major source of this rumble is the vibration of the motor, occurring at the rotation rate and its harmonics. For example, a 1500rpm motor can introduce 25Hz rumble (1500 revolutions per minute equals 25 revolutions per second) which might be audible through a good speaker system, and its multiples (50, 75 and 100Hz) could be reproduced by almost any speaker.

One method for eliminating audible rumble at its source is to use a lowspeed, multipole motor. These typically operate from 200 to 600 rmp, and therefore have basic rumble rates from 3 to 10Hz. These subsonic rumble components and their overtones are unlikely to be heard directly under any listening circumstances, although they can still provide an initial undesirable drive to the amplifier and loudspeaker.

Obviously, since these motors run faster than the record-playing speed, they have to be geared down in some way. However, the ultimate in low-speed drive motors is the direct-drive system now used in several rather expensive turntables. These use either multipole AC motors or special DC motors driven by solid-state electronic oscillators and servo amplifiers and operating directly at 33 1/3 and 45rpm.

With basic rumble rates as low as 0.5Hz, even the higher harmonics are well below the typical tone-arm/cartridge resonant frequency (10Hz or so) and should seldom reach the amplifier, let alone the speakers. Although these direct-drive systems have a complex internal structure and associated electronic circuitry, their mechanical operating components have been reduced to the vanishing point (basically one moving part!). No vibration isolating mounts are used; the motor can safely be mounted directly on the base-plate chassis. Speed changes are entirely electrical, as are the vernier speed adjustments provided on these units.

An intermediate form of turntable drive uses an electronically controlled motor operating at speeds from about 80 to 300rpm and driving the platter through a conventional belt system.

The transfer of rotational energy from the motor to the platter takes place in one of three ways: directly, through a flexible belt, or through a rubber "idler" wheel. Belt drives tend to reduce rumble and flutter (the belt isolates the motor vibration from the platter), but they have trouble transferring the torque necessary to operate a record-changing mechanism. Almost all automatic players therefore use an idler drive.

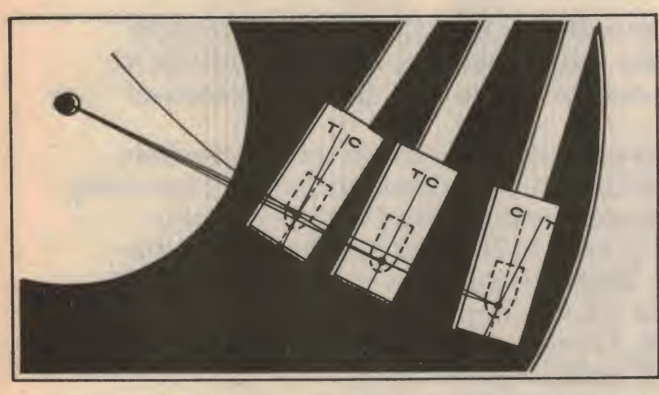
In practice, a good idler drive can be nearly as good as a belt-drive system, although the rubber idler itself (an inexpensive item) may require more frequent replacement than a belt.

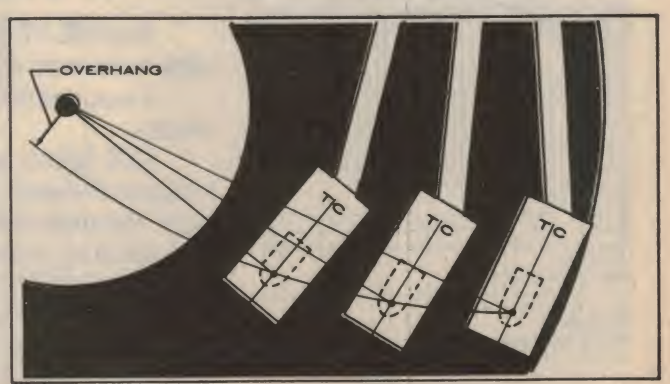
Changing the playing speed with a non-electronic system requires a motor shaft or an intermediate shaft with different diameters for each of the various speeds. The idler or belt is shifted mechanically to the appropriate part of the stepped shaft. The basic speeds of 33-1/3 and 45 rpm are offered on all turntables.

Some automatic record changers (usually the less expensive models) also have 78rpm, and a few may still include 16-2/3, for which there are virtually no records these days. Needless to say, these added speeds have no value to the great majority of users, who have only LP's or 45rpm records in their collections.

Many high-quality turntables have vernier adjustments that permit varying the rotational speed several percentage points above and below the nominal speeds. This feature is of interest principally to those people who like to play an instrument to accompany a recorded performance, and who must therefore be able to adjust the record for exact pitch. Some of these units have illuminated stroboscope markings, visible while a record is being played, which enable the user to adjust speed exactly.

• ADVICE TO BUYERS: A turntable should be quiet, smooth, and vibrationless in operation. Aside from making sure that the playing speeds you want are provided, you should also check the drive system used (belt, idler, or direct drive), since this will have a bearing on future maintenance. Work the speed-change switch and other controls several times to see that the turntable responds positively. The controls likely to be used while a record is playing should not jar the tone arm enough to cause jumping or groove skipping. If the turntable has a stroboscope indicator you can check to see that the speed doesn't change significantly under various playing conditions.





Figs. 1 and 2. The above diagrams show straight (left) and angled (right) tone arms playing a record. Tangency to the groove is achieved when the short, solid "tangent" lines (T) coincide with the centre line (C) of the cartridge. The straight arm is properly tangent at only one point on the disc. The angled arm is able to maintain tangency with very little error over the full record side.

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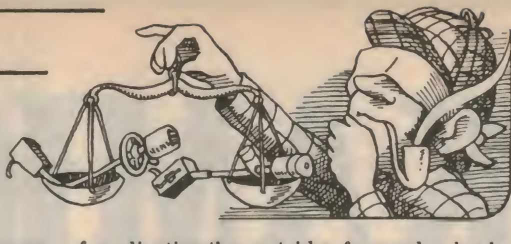


TONE ARMS

The vast majority of record players come with a tone arm already mounted although a few expensive manual turntables are not so equipped, permitting you to choose among the several separate arms available. But whether the tone arm was built in by the manufacturer or mounted by you, the conditions governing its performance are the same.

Usually the cartridge must be separately bought and installed by the user of any type of high-fidelity turntable, although a few record players — usually the more modestly priced automatic turntables in a manufacturer's line — are available with a cartridge already mounted.

The reason for the bent or curved shape of most tone arms is to keep the phono cartridge parallel to (or, more precisely, tangent to) the direction of the groove as it moves in toward the centre of the record. Deviations from tangency give rise to a form of distortion that, while perhaps not as audibly serious as other types, is certainly worth getting rid of if possible.

A straight arm pivoted at one end is geometrically incapable of achieving tangency except at one point on the record, and elsewhere it exhibits errors — called lateral tracking-angle errors — of considerable magnitude (see Figure 1). However, by forming an angle in the arm and carefully positioning it and the phono cartridge so that the arc described by the stylus "overhangs" the turntable spindle by a designated amount, lateral tracking-angle error can be reduced to zero at two points on the record surface and limited to acceptably low values elsewhere (see Figure 2).

A few arms (Rabco devices and the new B & O player) achieve virtually perfect tangency with a motorized mechanism that drives the cartridge straight in toward the turntable spindle along a radius of the disc. As a side benefit, this also eliminates the "skating" force generated by the angular offset of conventional arms. However, these units are quite expensive and are not used in automatic record changers.

An alternate arrangement is the sort of articulated tone arm used on some Garrard automatic players. It is pivoted at one end in the conventional manner, but the design is such that the angle of the cartridge holder changes as the arm moves across the record. Near-perfect tangency is the result, but the lateral friction of this type of arm may be marginally higher because additional pivots are needed to alter the cartridge angle.

An error of only one-sixteenth of an inch in cartridge mounting, or in the arm-mounting position relative to the turntable centre, can introduce enough tracking error to nullify the benefits of a good arm design. When installing either a tone arm on a motor board or a cartridge in a tone arm, use the templates or jigs supplied, and take the time to be as accurate as possible.

Cartridge dimensions, including the distance from the stylus to the mounting holes, are not uniform throughout the industry. It is therefore necessary to provide a means for adjusting the cartridge forward or backward in the arm in order to achieve the lowest possible tracking error. There are usually slotted holes in the cartridge mounting shell by means of which the cartridge can be positioned longitudinally before the screws are tightened. A plastic jig is often supplied with the arm to locate the stylus correctly.

Some turntables have a convenient post or index mark on the motor board for this purpose, together with an externally accessible screwdriver slot for moving the cartridge within the shell after it has been installed.

The friction in the tone arm pivots must be significantly lower than the forces exerted by the record on the stylus. Practically speaking, the pivot friction is unlikely to affect cartridge performance if it is less than 10 per cent of the vertical tracking force (the downward force of the stylus on the record-groove walls). All tone arms of reasonably good quality can meet this requirement with current cartridge designs.

The actual pivot design may take various forms, including needle points, ball bearings, or knife edges. Some arms use a gimbal structure whose principal feature is the uniform freedom of movement it allows along different axes.

Most of today's tone-arm designs balance the mass of the arm and cartridge about the vertical axis by an adjustable counterweight in the back of the arm. Once the arm is "zero" balanced, the necessary vertical tracking force is added by a spring, another movable weight, or by a slight readjustment of the counterweight. All of these methods are equally effective.

Some arms have rather impressive configurations of sliding weights on different axes to balance the arm so that the turntable can be tilted in any direction without affecting arm balance or stylus force (this is best accomplished when the vertical tracking force is provided by a spring). If your record player is to be operated in a yacht, airplane, or house trailer, this may be something to consider, but in most cases its importance is minimal.

The tone-arm (and cartridge) mass referred to the stylus, together with the compliance of the stylus assembly, determines the low-frequency resonance of the arm. For minimum sensitivity to any possible record warp and full response to the lowest recorded program frequencies, this should fall into the 7 to 12Hz range. Actually, there is little one can do about the frequency of this resonance other than to use a cartridge whose design is compatible with that of the arm.

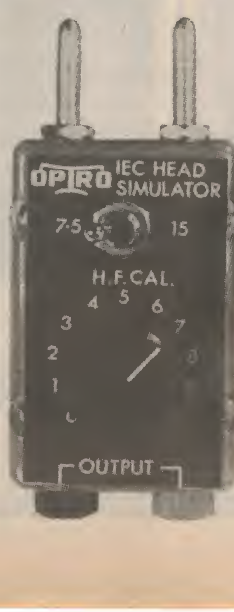
If common sense is applied, serious mistakes can be avoided. Do not try to use a new expensive, high-compliance cartridge with an older, massive arm. Equally unwise would be the pairing of a low-price, stiff cartridge designed to track at 3 or 4 grams or higher with a low-mass, highly refined tone arm designed for the latest and most advanced cartridge designs. Some of the better record players and tone arms help to prevent this sort of mistake by having a vertical tracking-force adjustment limited to a maximum of 3 grams.

The accuracy of an arm's stylus-force calibration is often taken for granted, but my experience shows that many arms have errors of up to several tenths of a gram when balanced according to instructions. If you are operating a cartridge at 2 or 3 grams, this error is negligible, but at 1 gram it can be serious, especially if it is in the direction of too little tracking force. Always use an accurate external stylus gauge to set tracking force for a cartridge operating at less than about 1.5 grams.

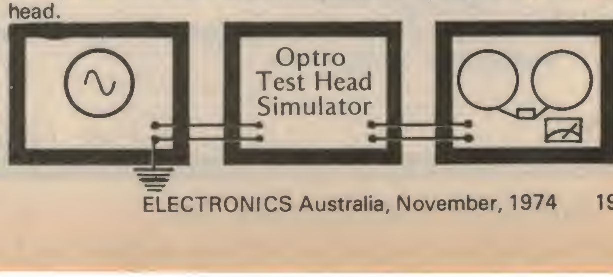
• **ADVICE TO BUYERS: Correct tracking force and proper mounting of the cartridge are crucial to the optimum performance of a tone arm. Try to familiarize yourself with these adjustments in the store, consulting the owner's manual (if available) to make sure the instructions are sufficiently clear and detailed. If at all possible, audition any turntable with the cartridge you are planning to use, and listen for any audible effects that might indicate record-warp instability or other problems with that arm-cartridge combination. Watching the stylus closely from the side as it plays a warped record is a good way to correlate any disturbances you hear with what is happening at the record surface.**

(To be continued)

Test Head Simulator



Paralleling the role of a "dummy antenna" in an RF test situation, a tape head simulator has been announced by Optronics Pty Ltd, of 11 Milgate Rd, South Oakleigh, Vic, 3167. In use, the tape playback circuitry is disconnected from the normal head and connected instead to the simulator. Input is applied to the simulator directly from an audio generator. Signal is fed through the system at representative spot frequencies and the "Cal" setting of the head simulator noted which is necessary to maintain the VU meter of the replay amplifier at reference. In the event of subsequent trouble, repeating the test will indicate whether the amplifier has changed its characteristics or whether the problem lies in the head.



NAKAMICHI:

"The Nakamichi 1000 must surely be considered the Rolls Royce of cassette recorders with its 2 noise reduction systems (Dolby and Philips DNL), variable speed, separate record head for monitoring facilities, IC logic control, and a host of other features."
American AUDIO Magazine, March, 1974.

"We would rank it for now as the best cassette recorder we've tested and one of the best tape recorders of *any* we have ever used."
STEREO REVIEW of U.S.A., December, 1973.

"All told, a unique and fascinating product."
HIGH FIDELITY MAGAZINE, OF U.S.A. August, 1973.

"I found the Nakamichi 1000 and the 700 cassette decks to be aristocrats of the cassette world."
AUSTRALIAN FINANCIAL REVIEW, 31st May, 1974.

3 HEADS

"In conventional cassette machines this narrow head gap cannot be exploited because of the functions of the playback head and the record head are combined in one unit. The Nakamichi machine overcomes this difficulty by using 3 separate heads."
ELECTRONICS TODAY INTERNATIONAL, October, 1973.

". . . there are separate record and playback heads, each can be designed for optimum results. Thus, the gap in the record head is 5 microns but the playback head has an exceptionally small gap of only 0.7 microns!"
American AUDIO, March, 1974.

AZIMUTH ALIGNMENT

"Azimuth Alignment meaning the absolute right angle of the record and playback heads across the tape width. If either head is misaligned one loses high frequency sound."
AUSTRALIAN FINANCIAL REVIEW, 31st May, 1974.

"The knurled screw is then adjusted until the correct indication is given by a pair of light emitting diodes. After one has become familiar with the procedure, the whole operation takes about 6 seconds to perform."
ELECTRONICS TODAY INTERNATIONAL, October, 1974.

REEL-TO-REEL

"The first cassette machine that . . . is equal in every respect to top quality reel-to-reel recorders."
ELECTRONICS TODAY INTERNATIONAL, October, 1974.

". . . its performance is essentially comparable to that of open-reel decks in the same price range."
STEREO REVIEW, December, 1973.

"After the various measurements were taken, recordings were made and they compared very favourable with those made with a standard open-reel machine."
AUDIO, March, 1974.

"Almost incredibly, we could not detect any difference between the Nakamichi and the Nagra . . ."
ELECTRONICS TODAY INTERNATIONAL, October, 1973.

DOUBLE NOISE REDUCTION

"When you want noise reduction in the recordings you're making, the Dolby B system is there: when you want to reduce apparent hiss without audibly affecting the music, the DNL system is there as well. These two can be used simultaneously."
HIGH FIDELITY MAGAZINE OF U.S.A., August, 1973.

IC LOGIC ELECTRONIC CONTROLS

"When you switch from one transport mode to another, this logic system is carefully designed to time the sequencing of events . . . . All this avoids audible start-and-stop wows and switching transients in the monitor circuit."
HIGH FIDELITY MAGAZINE OF U.S.A., August, 1973.

"The control logic . . . has been very carefully thought out to provide click-free operation of the highest professional standard."
ELECTRONICS TODAY INTERNATIONAL, October, 1974.

TAPE DRIVE MECHANISM

"The double capstan system creates a constant, stable, tension between the two capstans. The condition of the tape between the two capstans is not affected by external conditions such as irregular tape up, supply torque, or uneven winding of the tape. The two fly wheels are physically large and the overall performance is further enhanced by a pneumatic damper . . ."
ELECTRONICS TODAY INTERNATIONAL, October, 1973.

SUMMARY

"We were unable to find any signal source with anything like a normal dynamic range that could not be reproduced on the 1000 so faithfully that we were unable to distinguish between the copy and the original."
HIGH FIDELITY MAGAZINE OF U.S.A., August, 1973.

". . . Nakamichi has achieved results which would have been thought absolutely impossible not so long ago. Not only that, but they have come up with a professional machine that is even simpler to operate than an ordinary domestic recorder!"
American AUDIO Magazine, March, 1974.

MEMO TO NAKAMICHI

"Memo to Nakamichi -- please, do not ask me to return the recorder yet!" George W. Tillett, test authority.
American AUDIO Magazine, March, 1974.

Nakamichi 1,000

Nakamichi 700

L & G FM-AM stereo receiver with "mod" styling

Old-man brown and spinster-black are out. So says the pamphlet for L&G audio products, which have "new colour concepts". Here we review the L&G 3400 stereo receiver.

Appearance of the L&G equipment is quite different from other brands. On the 3400, the front panel is a diecasting finished in off-white enamel. The push-buttons and slider knobs are orange while the dial scale and tuning knob are a deep indigo blue. L&G state in their pamphlet that the styling is intended to complement modern decor. No doubt this is correct, but then it may not suit homes with a more traditional decor! One can't have everything . . . .

When the unit is turned on, its appearance improves (in my opinion) when the dial scale is illuminated in white. However, the styling is likely to polarise hifi buyers — some will and some won't.

On the rear panel, appearance is more familiar with phono sockets being provided for the inputs and spring loaded terminals for the loudspeaker connections. A 5-pin DIN socket is provided for connection of a tape recorder.

Overall dimensions are 424 x 112 x 294mm (W x H x D) and weight is 10kg.

Inside, the unit is neatly laid out with quite a few PC boards; interconnections have been kept to a minimum. The output transistor heatsink is mounted wholly within the chassis so that no transistors are exposed on the rear panel.

We found the feel of the controls less satisfactory than that of other amplifiers and equipment originating from Japan. The slider controls tend to have uneven friction along their length of travel and the dial cord was slipping. The AM/FM/FM muting selector switch next to the tuning knob seems to be a hasty afterthought.

It should be common knowledge by now that unless a mains-powered appliance is double insulated, it must be fitted with a three-core mains cord. So we must criticise this L&G receiver for not having the correct cord. In any case, it must be earthed other wise hum is a problem. We hope that those sold to the public will have this rectified.

A brief but well written manual is provided with the receiver and the circuit diagram is included. But nowhere did we find any reference to the necessity for the unit to be earthed in order to minimise hum when a magnetic cartridge is in use. The manual did make mention of the GND terminal on the rear panel for grounding the record player or grounding the receiver. This may cause some problems with customer relations.

As this issue goes to press, experimental FM transmissions now seem likely in Sydney and Melbourne soon. For those interested in listening to FM now and in the future, its FM tuner specifications appear quite competitive with other brands.

A ferrite rod antenna is mounted on the rear panel for AM broadcast reception. The rod hinges out, but remains parallel to the panel. It would be preferable if it was hinged at one end, so that it could be easily oriented for best reception.

The AM tuner facility is just a run-of-the-mill tuner. Not that we expected anything else, as most AM tuners incorporated in stereo FM receivers are of secondary interest only in the countries which have FM reception. The fact remains though, that a modest AM tuner cannot possibly approach the quality that is possible with local AM broadcast transmissions, particularly those of the ABC.

Circuitry of the power amplifier sections of the L&G 3400 is fairly conventional with quasi-complementary output stages driving the loudspeakers via 220uF capacitors. Thermal compensation for quiescent current variations is comprehensive with two diodes plus a thermistor used in each channel.

Tone control circuitry is also conventional. High level signals from the phono preamps and auxiliary inputs are fed to a common-emitter stage with a gain of approximately four and thence to negative-feedback (Baxandall) tone control stage.

A less common feature of the L&G 3400 is that the phono preamplifier uses an integrated circuit in each channel. Up till now these have not been common because of the difficulty in obtaining a satisfactory signal to noise ratio.

With a high supply voltage and modest gain in the preamplifier it is possible to obtain a high overload margin. Nominal phono input sensitivity is 2.2mV, and we measured it at 2.5mV at 1kHz and the maximum signal before overload occurs at the same frequency at 130mV. This is an excellent figure.

Nominal frequency response of the 3400 is quoted at 20Hz to 40kHz for the minus 3dB points. We measured it at one watt into an 8-ohm load and found it to be 15 to 80kHz at the minus 3dB points.

As can be imagined, the square wave response even at 10kHz was excellent. Capacitances up to 1uF shunting the load caused only slight ringing with a 1kHz square wave signal. By comparison, with a 10kHz square wave, capacitances from .01 to 0.1uF caused severe ringing when shunted across an 8-ohm load, however this is quite a severe test. One can state that stability with capacitive loads is good.

Power output of the L&G 3400 into 8-ohm loads is quoted as 25 watts RMS from a single channel and 20 watts per channel with both channels driven simultaneously. We measured power output at 23 watts RMS into a single channel and 20 watts RMS with both driven.

Rated distortion is 0.5 pc up to maximum power. We found it to be typically about 0.1pc for normal input and power conditions.

Signal-to-noise ratios were 56dB unweighted for the phono inputs (of which there are two pairs) and 80dB for the auxilary inputs. The phono signal to noise ratio was the same whether the input was open-circuit or short-circuit and is about average for the circuitry used.

In practice, the amplifier is quiet and free of any vices. It has good power output and considering its ability to be able to receive future FM stereo multiplex transmissions when they are finally initiated, the L&G 3400 is a good buy.

Recommended retail price for the L&G 3400 is $249.00 including sales tax. For further information about L&G products which include amplifiers, turntables and loudspeakers, contact the Australian distributors for L&G, Contronic Distributors Pty Ltd, 657 Pittwater Road, Dee Why, NSW. (L.D.S.)

Acoustica Dynastatic has Australian electrostatic tweeter

Manufactured by Tasman Acoustics Pty Ltd, the Acoustica Dynastatic is an interesting hybrid with a large conventional woofer and a widerange electrostatic tweeter which is exclusively made in Australia. The electrostatic is claimed to provide great improvements in sound definition.

In appearance, the Acoustica Dynastatic is little different from a great many other loudspeaker systems currently on the market. It has an attractively veneered cabinet with a sombre brown front fabric. One indication that it is perhaps a little different is the neon pilot bezel next to the "Acoustica" label.

On the rear of the enclosure, which has a flecked paint finish, is a recessed panel carrying a pair of screw terminals for the connection of the audio signal, with a polarised three-pin female socket for the mains supply.

Dimensions of the Acoustica are 350 x 600 x 300mm (W x H x D) and the weight is 14kg.

Removing the tight-fitting front grille of the Acoustica reveals that it is very different from conventional loudspeaker systems, in that it has a large electrostatic tweeter mounted in the lower section of the cabinet.

Of Scandinavian origin, the woofer is a low resonance unit with a large synthetic roll surround and a curvilinear paper cone. It has an alnico magnet of modest proportions and an effective cone diameter of 180mm. The enclosure for the woofer is completely sealed and well packed with fibreglass wadding to effectively damp major resonances.

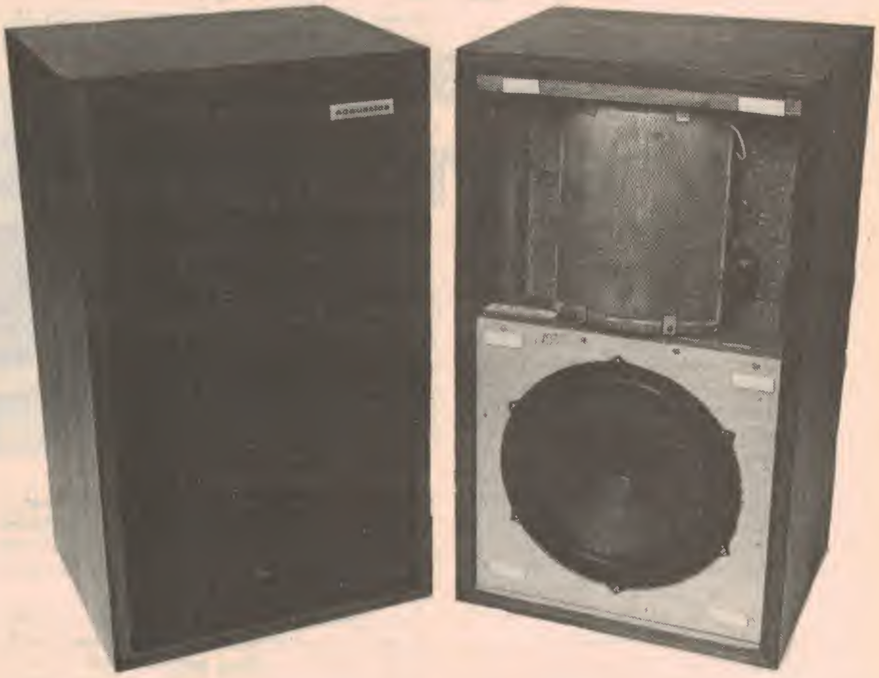
In spite of the relatively small enclosure volume for a woofer of this size, its low free-air resonance enables a system resonance of about 44Hz to be obtained. Nominal impedance of the Acoustica Dynastatic is 8 ohms and cross-over frequency from woofer to electrostatic tweeter is 2kHz.

The tweeter is an imposing looking mechanism with approximate dimensions 230 x 180mm, and it is slightly curved to improve horizontal dispersion. Construction of the tweeter is basically as a sandwich — two perforated steel plates with a very thin metallised membrane tautly suspended in between them but not touching.

Polarising DC voltage for the tweeter is derived directly from the mains via a half-wave voltage doubler rectifier. Audio signals are stepped up in voltage and fed to the tweeter via a fairly large transformer lso mounted behind the tweeter are the crossover network and rectifier components.

An interesting freaure of the tweeter is that no signal connection is provided for the membrane of the tweeter — yet this is the part that actually moves back and forth to provide the sound. The signal is effectively coupled to the membrane via the capacitive voltage divider formed by the perforated steel plates and the membrane itself.

Using a capacitive divider not only eliminates the need for a centre-tap connection for the transformer secondary, but also neatly solves the serious problem of how to make an electrical connection to the membrane which is only .0015 inch thick and is made of metallised Mylar — hardly the sort of material you can solder a length of hook-up wire to.



When the Acoustics Dynastatic is connected to the mains and switched on you get an audible indication that the unit is working because the membrane produces a slight "crinkling" sound as the polarising voltage is applied. After this initial sound, though, the unit is completely silent. Its power consumption from the mains is negligible.

Tested with a signal generator and power amplifier, we found the bass output of the Acoustica generous and well maintained down to below 50Hz. By comparison, the treble output was modest and tapering above about 8kHz. Comparing it with other loudspeakers of known good quality, we found it lacking in brilliance — although there was no denying the general smoothness of the treble reproduction.

The manufacturer states that power handling capacity of the unit is 30 watts RMS, but we found that even a 50 watt per channel amplifier did not drive a pair of them to overly loud sound levels. Clearly, a high power amplifier is a must for this system.

We found that the best overall balance from the system was obtained with a modicum of bass cut and a fair amount of treble boost. Under these conditions, the system sounds pleasant, has no obvious vices and is capable of providing hours of fatigue-free listening.

Recommended retail price of the Acoustica Dynastatic is $179 each which includes freight to any part of Australia. Warranty period is 2 years. Further information can be obtained from the manufacturers, Tasman Acoustics Pty Ltd, 62 Tamar Street, Launceston, Tasmania, 7250. (L.D.S.)

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AUSTRALIAN SUCCESS STORY

IRH ups metal glaze resistor production

At a time when many Australian companies have been forced to close down their production lines as a result of the Federal Government's decision to reduce import tariffs on electronic components and equipment, IRH components has spent several hundred thousand dollars on expanding its activities. And that's not all IRH has to boast about: the company is the largest manufacturer of resistive products in the southern hemisphere, and it is totally Australian owned.

Originally established over forty years ago as International Resistance Company (Australasia) Pty Ltd, IRH has recently been restructured and makes it apparent that it is here to stay. Some two years ago, Kemtron Ltd bought a 49pc interest in IRH Industries Ltd, the then holding company for the Natronics-IRH-Conqueror Cables organisation. Component manufacture is now being carried out by the IRH Components Division, with Natronics Pty Ltd as the operating company.

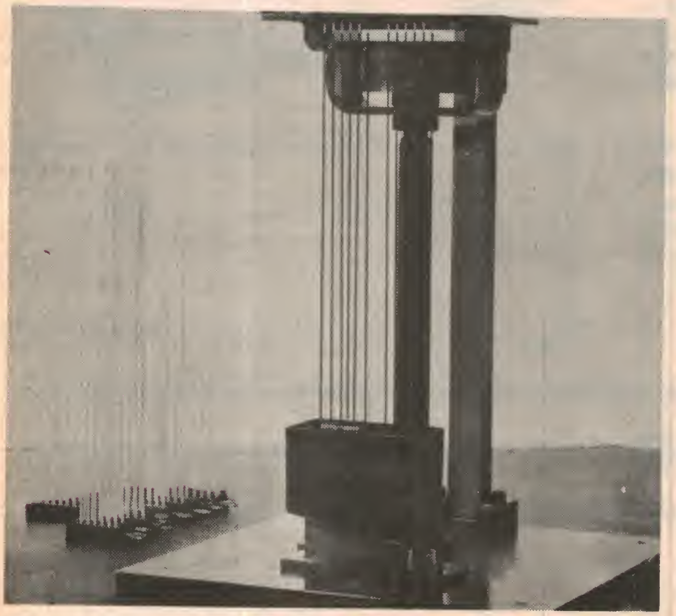
At the time of the Kemtron share purchase, the IRH manufacturing centre and headquarters at Kingsgrove, NSW, was manufacturing a range of carbon resistors, wirewound resistors, ceramic capacitors and small quantities of metal glaze resistors. These production lines are still busy today, but it is the metal glaze resistor, manufactured under licence to the IRC Division of TRW (USA), on which the expansion program is based.

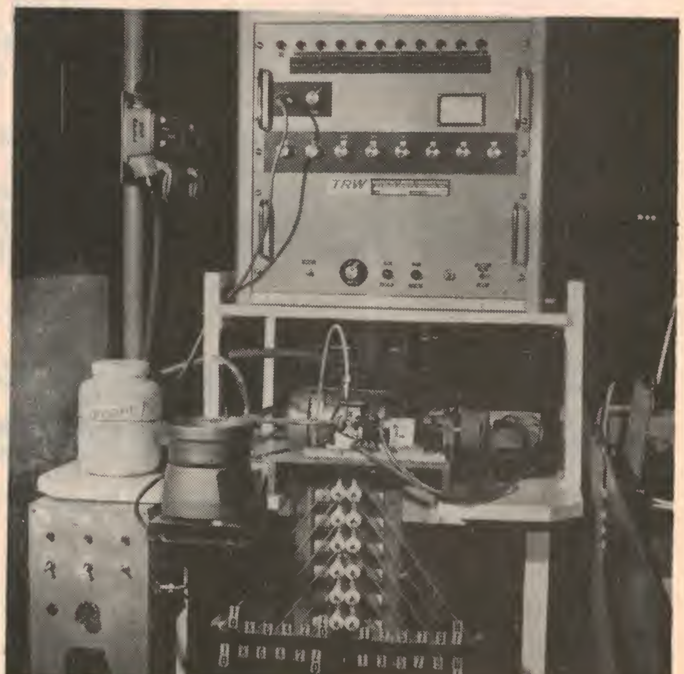
IRH commenced manufacture of the IRC metal glaze resistor in 1967. However, at that time, production techniques involved the same labour intensive techniques used in the manufacture of high stability carbon deposition resistors. As such, the new resistor was suitable only for specialised applications, such as in Post Office equipment and in equipment for the armed services where high reliability is required.

While justified for specialised applications, the metal glaze resistor was at a cost disadvantage for general use compared with conventional carbon types. That was until intensive research by IRC (USA) resulted in the development of a unique mass production process which dramatically reduced the labour content and enabled the metal glaze resistor to be competitively priced. The result was a resistor that was rugged, extremely stable and suitable for all applications. It was half the size of conventional resistors of comparable wattage based on the older carbon composition and cracked carbon technologies and, in addition, could be readily manufactured with 5, 2 or 1pc tolerances.

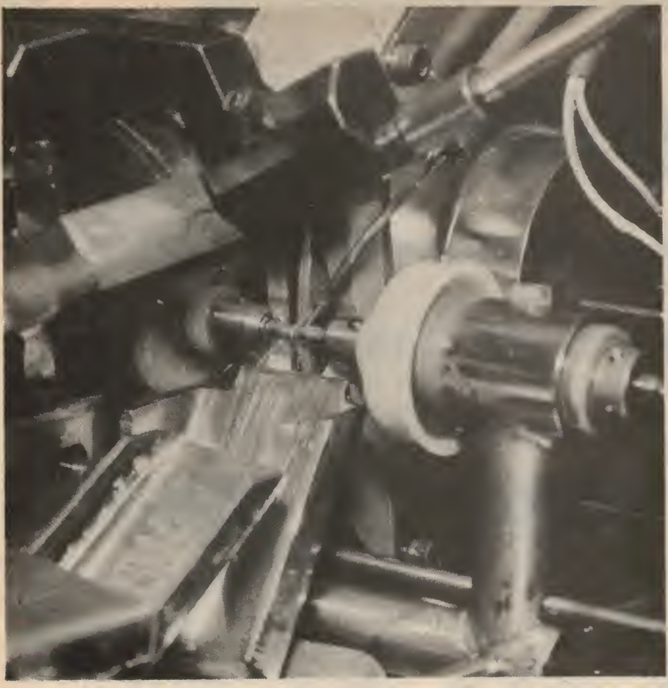
IRH examined the new mass production technique developed by IRC in relation to the low volume Australian market and the high cost of importing the specialised equipment needed. The project received the go-ahead when it became apparent that IRH engineers were capable of building most of the critical electronic plant equipment, either from original designs or from modified IRC designs. A high proportion of the mechanical engineering was also carried out within the plant.

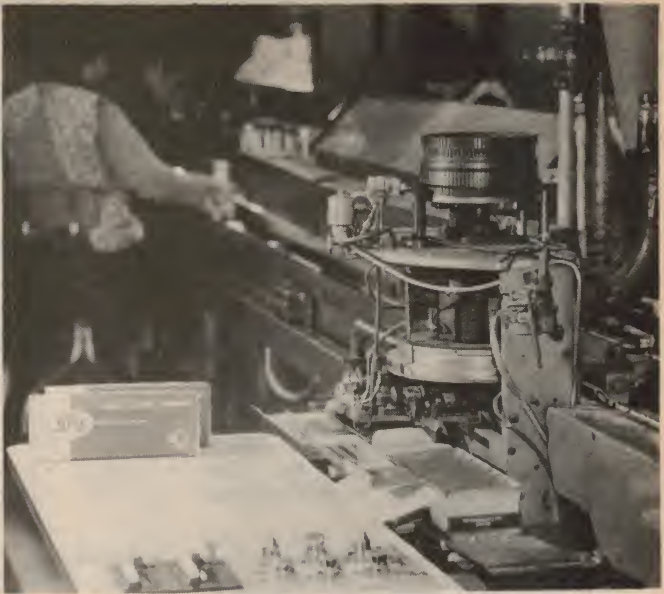
The outcome was a modern mass production metal glaze resistor plant installed at a cost of several hundred thousand dollars. Situated at Kingsgrove, NSW, the new plant forms an addition to IRH's existing facilities. The production capacity of the plant is such that it is capable of providing in excess of the total Australian requirement for ¼W, ½W, and 1W resistors at prices which are competitive with imported resistors. In fact,





Above, liquid glaze is applied to the alumina ceramic rod by dipping and withdrawing at a controlled rate. At right is the binner which automatically sorts elements into narrow resistance bands.





At left, selected resistance elements are automatically helixed to their desired resistance values by the "spiraller." Above is the automatic testing and boxing station.

IRH intends to export excess production quantities.

The method of manufacturing thick film metal glaze resistors involves quite a number of production steps. The metal glaze material itself consists of a mixture of finely divided metal powders and a glass powder, in suspension in a proprietary liquid. When applied to a ceramic rod and fired at 1000deg C (or more), a glass-like film is obtained.

The metal phase of the glaze composition usually involves two or more metals or metal derivatives. These metals include the precious metals gold, silver, palladium, iridium and ruthenium, and the refractory metals tungsten, tantalum and titanium. The derivatives are oxides, nitrides or carbides of the refractory metals.

By varying the combinations of these metals and their derivatives, it is possible to produce a range of glazes, each suited to a particular requirement. For example, the glaze may be deliberately given a fuseable non-flaming characteristic for applications where it would otherwise be a potential fire hazard. Alternatively, the glaze can be made to take repeated overloads without fusing or changing value until, at a certain overload point, the resistor will act as a current limiter and protect the circuit by increasing rapidly in resistance value.

The production process begins by dipping several long (280mm) alumina ceramic rods into the metal glaze suspension, and withdrawing the rods at a controlled rate to control the film thickness. The metal to glaze ratio is selected to achieve the desired resistance value. The rods are then fired at a temperature of approximately 1,000deg C, melting the glass in the film coating and creating a form of micro-encapsulation for the metal particles. In addition, the glass phase forms an integrated film boundary with the vitreous phase in the rod. The result is a glass like film of encapsulated metal particles covering an alumina ceramic substrate.

After firing, the rods are sawn en masse with a diamond wheel into short lengths which are then treated in bulk quantities to electrolytic plating and a 309deg C solder dipping process.

The next step is to automatically sort all the pieces or "elements" into narrow resistance bands. The equipment employed here is known as a "binner," and is depicted in one of the accompanying photographs. Following this operation, an element lot is subjected to a quality control acceptance test which includes visual, temperature coefficient, short-term overload and other tests designed to reject non standard batches. Accepted element batches are then stored until needed, the excellent shelf life characteristics of the glaze permitting unlimited storage times with no measureable change in resistance values.

The next stage in the process is to spiral or helix the elements to the desired preferred resistance value. This value may be between 10 and 100 times the basic element value. The resistance value of the element is monitored electronically by the "spiraller" during the spiralling process. When the desired value is arrived at, the element is automatically removed from the diamond cutting wheel, dropped into a bin, and the next element presented for cutting.

The spiralled elements, together with nail-head shaped leads (see cutaway drawing) are fed onto travelling racks which carry them under a twin gas jet reflow solder station. The resulting sub-assemblies are then each subjected to a short duration high overload which eliminates imperfect sub-assemblies and effectively "sets" the resistance value of the remainder. Finally, the sub-assemblies are moulded in a thick jacket of flame resistant mica-filled moulding material, colour branded, and 100pc resistance checked at an automatic testing and boxing station.

Above, the gas jet reflow solder station. This stage of the process solders the nail-head shaped leads to the resistance elements.

IRH's metal glaze process offers several unique design features and operating advantages over the older carbon composition and carbon deposition technologies. These advantages are as follows:

- Lower operating temperatures due to the excellent heat conductivity of the alumina ceramic substrate and the "nail-head" soldered lead;
- Greater surge and overload capabilities as a result of the 10 micron thick cermet film (over 100 times thicker than that used in thin film metal or carbon resistors);
- High stability over the whole range of resistance values. This is due to the use of a uniform film thickness over the whole resistance range, and to the use of plated wrap-around terminations at the electrical interface with the glaze film;
- Long term reliability due to the glass encapsulation of the conductive metal particles. The resistance is thus effectively "frozen;" and
- Close tolerances to initial resistance values due to the fact that the value of each element is automatically tested during the spiralling process.

IRH believes that its future is assured due to its competitive prices, the coming introduction of colour TV, and the anticipated expansion of the industrial electronics and telecommunications fields. In fact, the company is already constructing another bank of spiralling machines which will enable it to double its metal glaze resistor production, probably by the end of this year. Further production increases are projected for 1975, making it apparent that IRH is determined to play an increasing role in the future of Australia's electronics industry.

News Highlights

Balloon-borne communications may become reality

A $US10 million contract for two balloon-borne, wide area broadcasting systems has been awarded by the National Iranian Radio & Television (NIRT) to TCOM Corporation, a subsidiary of Westinghouse Electric Corporation.

Two channels of television and two FM radio stations will be broadcast to the Southwestern and Southeastern regions of Iran. The transmitting equipment is suspended from a new aerodynamically-stable, tethered balloon, called an aerostat, at an altitude of 10,000-15,000 feet (about three to five kilometres). The broadcasting systems are expected to be operational by mid-1975.

Electronic gear suspended from the aerostat can broadcast television and radio signals and provide other direct line-of-sight communications to a 50,000-70,000-square-mile (130,000-180,000-square-kilometre) area, which would almost cover the state of Victoria. To cover larger areas, information can be relayed from one aerostat to another.

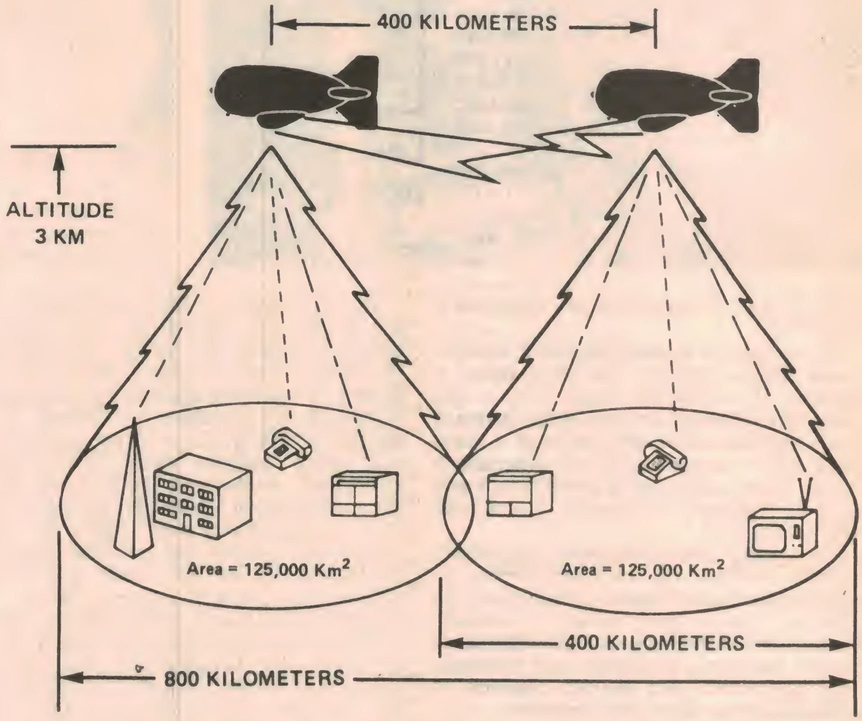
According to Richard S. Cesaro, president, TCOM Corporation, Westinghouse first experimented in the US with a tethered-balloon broadcast system in 1920, when KDKA Radio in Pittsburgh, Pennsylvania, used a balloon to support a broadcast antenna during the Harding-Cox presidential election.

"However stability problems and lift restrictions curtailed the use of tethered balloons for communications until recently when several technological breakthroughs were made," said Mr Cesaro. "These include advances in materials technology, computer-aided aerodynamic design and electronic miniaturisation.

"A tethered communications system using modern aerostats can now provide a low-cost highly flexible telecommunications and broadcasting system to nations which presently have only a limited system," Mr Cesaro said.

When tethered at 10,000 feet, the transmitting equipment on board a TCOM aerostat can provide line-of-sight radio and television broadcasting to a 125-mile (200-kilometre) radius area. This broadcasting method substantially reduces transmitter power requirements and increases the effective broadcasting area. As an example, the signal strength received at a location 100 miles from a 1000-foot conventional broadcasting tower with a radiating power of 100,000 watts could be equalled with only 3.2 watts from the aerostat-supported transmitter.

Commercial, informational or educational television programming can originate at a distant city, be transmitted to the TCOM aerostat with a microwave link and then be broadcast from the aerostat.



Programming can also originate at the TCOM control station, or standard television programming can be picked off the air and rebroadcast on another VHF or UHF channel to prevent any interference.

The television broadcasting equipment suspended from the aerostat has the capability to broadcast either colour or black-and-white video signals. If desired, the broadcast area can be restricted by changing the design characteristics of the broadcast antennas.

The telecommunications capability includes accommodations for several thousand channels of mobile and stationary telephone communications, teletype, telex and telephoto channels, high-speed digital and analog data channels, collection and relaying of meteorological and other types of information over a wide area.

A single TCOM aerostat installation can take the place of about 15 conventional microwave towers while having much broader communications capability.

Mr Cesaro said, "An aerostat-borne communications system will initially cost about 20 percent of a conventional microwave and broadcast tower system and will have less than ten percent of the operating costs. In addition, the initial aerostat system can be installed in less than half the time necessary for a conventional network and can be easily relocated if the need should arise.

An additional advantage is the flexibility of the aerostat system, which allows the addition or change of communication functions. "This can be of particular advantage to a developing nation where a single-purpose communication system may not be the most desirable," commented Mr Cesaro.

For highest system reliability, each TCOM station normally uses two aerostats tethered at the 10,000-foot level and spaced about a half-mile apart. Each aerostat carries an electronic receiving and transmitting package with automatic switchover capability from one aerostat system to the other should any type of malfunction occur. With automatic switchover and high inherent reliability of the electronics, the system will have equal to or better reliability than achieved with conventional microwave towers.

The communications package suspended from the aerostat is designed so that it will always stay pointed in the same direction and remain at the same horizontal level. The aerostat is free to respond to changes in wind direction and speed while the communications equipment retains its proper orientation.

US — Britain to probe supernova remnant

The United States and Great Britain will undertake a joint rocket mission next June to aim an X-ray telescope at the remnants of a distant supernova. The project calls for the launch of a British Skylark sounding rocket from the Woomera Rocket Range in SA towards the Puppis A supernova remnant, an object of intensive study by scientists for several years.

A supernova originates in a large star at life's end, whose final collapse is a cataclysmic event that generates a violent explosion, blowing the innards of the star out into space. There the material of the exploded star mixes with the primeval hydrogen of the universe. Later in the history of the Galaxy, other stars are formed out of this mixture. Consequently, the study of the remnants of exploded stars such as Puppis A could provide important information on the evolution of stars and galaxies.

Puppis A, the subject of previous study by sounding rockets and the Copernicus (OAO-3) satellite, has been found to be one of the brightest soft X-ray sources in the sky. Telemetered data from the Skylark experiment will provide two-dimensional images of the X-ray-emitting regions of Puppis A which can be compared with previous observations to develop more precise "models" of the supernova phenomenon.

Studies by the Mullard group, using Copernicus, showed some evidence of a peak signal near the centre of the nebula, which might indicate a rotating neutron star.

TV station broadcasts tornado pictures

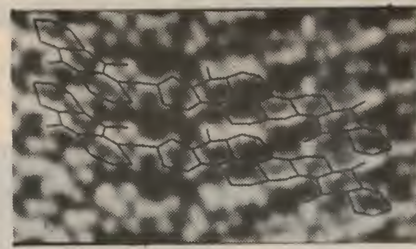
To most TV viewers in the United States, radar weather pictures are merely a means of helping the weather man to explain the weather forecast. But for many viewers of station WAAY-TV in Huntsville, Alabama, radar proved to be a life saver.

Recently, the WAAY-TV weather radar detected and tracked a series of tornados heading towards Huntsville, and the station transmitted live pictures of the dread storm funnels approaching the area. Many viewers, at first stunned by the scenes, were able to realise the imminent danger, and evacuate their homes. According to Bob Gay, WAAY-TV Chief Engineer, the station was "able to give . . . viewers at least 45 minutes warning. They could see the tornado coming in themselves, and they didn't need any more urging to get out of its way."

But for the spectacular pictures of successive "twisters" bearing down on their area, station officials believe that many residents would have chosen to sit out the storms, thereby adding to the heavy toll of 70 lives lost. Following the storm, the station received nearly 5,000 telegrams, telephone calls, and letters from people all over the area, thanking the station for the tornado alerts and the storm news coverage.

The WAAY-TV radar is mounted on the station's broadcasting tower and scans a full cirle some 150 miles out to pick up weather patterns. The radar is a type known as the AVQ-10 which was originally developed by RCA for use in aircraft weather detection.

High resolution atomic photograph



The image above is one of the first clear pictures of individual atoms linked together into chain molecules. It shows carbon, nitrogen and oxygen atoms in an organic dye, indanthrene olive. Two single molecules of the chemical are shown by hand-drawn lines connecting the atoms.

The procedure for obtaining atomic resolution with an electron microscope was recently explained at the Eighth International Congress on Electron Microscopy in Canberra by an American Scientist, Dr Robert Nathan.

The synthetic aperture technique employed by Dr Nathan involved taking a number of relatively high resolution images. These images are then processed by a computer to obtain a single image possessing atomic resolution.

Previous electron microscope pictures have shown large atoms as minute specks, however conventional methods have not given sufficient clarity at high levels of magnification to show individual atoms distinctly.

Laser used for real-time pollution measurements

A remote controlled laser, an opto-acoustic device and a computer suspended from a balloon 17 miles above the earth have enabled Bell Labs scientists to make the first real-time measurements of nitric oxide concentrations in the stratosphere. Nitric oxide is a major pollutant produced during combustion processes of all sorts, such as in automobiles, aircraft, power generation plants etc.

The laser-computer measurement system was part of a two-ton payload recently launched from the National Center for Atmospheric Research, Palestine, Texas. This balloon facility is operated for scientific investigations by the National Science Foundation.

The concentration of nitric oxide in the atmosphere is important because of the crucial role it and other oxides of nitrogen play in the chemical cycle of ozone. Ozone is instrumental in blocking hazardous amounts of ultraviolet radiation from reaching the earth below, says C. N. Patel, Director of the Bell Labs Electronic Research Laboratory. It is feared that man-made pollutants may upset this chemical balance.

— George E. Toles

British PO develops telex dialling aid

Britain's first dialling aid for Telex machines has been developed by the Post Office. The device, a modified version of the successful card callmaker, thousands of which are already being used in association with telephones, was made available throughout Britain during October. The card callmaker is a small automatic dialler linked to the telephone or Telex machine. Instead of rotating the dial by hand, calls are made simply by slipping a small plastic card into the auto-dialler.

Users of Britain's 50,000 Telex machines will be able to use the dialling aid for making calls within the UK and to mainland Europe. Although it cannot yet be used for international Telex calls which involve dialling and keying to get through, Post Office engineers are examining the possibility of developing a Telex dialling aid which will do this.

Numbers are stored on small plastic cards measuring 3½" by 2¼" — with one card for each number. Users programme onto each card the number they wish to dial by punching a pattern of holes according to a simple guide supplied with the callmaker. This then forms a permanent record for future use.

The callmaker's dialling unit, a small box-like device, uses a photo-electric "magic eye" principle to read the punched-out code on the dialling card. Calls are made by simply slipping the appropriate card into a slot on the dialling unit.

NEWS HIGHLIGHTS

Computer program detects typo errors

A computer program to take the drudgery out of catching typographical errors before they appear in print has been devised by two Bell Laboratories researchers.

The first of its kind ever developed, the program is fast, needs only limited computer storage capacity, and is easy for the proofreader to use, according to developers Robert Morris and Lorinda L. Cherry. The system is capable of detecting typographical errors in foreign languages as well as in English.

The new way of finding errors may be of use to book, magazine, and newspaper publishers, especially those having computerized typesetting equipment.

In the Bell System, the error detection program may be used for preparing such documents as instruction manuals, training materials and other internal documents. With about a million employees, the Bell System yearly spends several hundred million dollars on educational and training materials.

The computer program cannot detect errors without human assistance. After the original document is typed into a computer, an "index of peculiarity" for each word in the document is computed. The computer then displays or prints out a list of the words, with those most likely to contain errors listed first. It is then relatively easy for the proofreader to find and correct typographical errors.

In one trial of the system, a 108-page document of nearly 20,000 words was examined for errors in three minutes by the computer. The author of the document needed less than ten minutes to scan the word list and locate 30 misspellings — 23 of which occurred in the first 100 words listed by the computer.

The system cannot do all parts of the proofreading job, however. For example, it does not find missing or extra words, or semantic nonsense.

In assigning every word in a document an index of peculiarity, the computer program first breaks down each word into all possible two and three-letter segments, known as digrams and trigrams. With that information the computer compiles and stores a table which shows the number of times each such segment appears in that particular document. This table varies with each document, of course, since it is totally dependent on the author's choice of words.

Next, the computer takes each word in the document and looks up the digrams and trigrams it contains in the frequency table it made for the document. It then assigns a number from zero to twenty for the word's "index of peculiarity," depending on the rarity of the letter combinations it contains. The words are then printed out or displayed in a list with those having the highest index at the top.

To keep list length down, words in the document that match those on a stored list of about 2[illegible]0 words often used in Bell Labs documents — such as "the", "in", "Bell", and "Labs" — are not printed out for proofreading. A similar list of "often-used words" might be generated by any other user of the program.

Because the table of digram and trigram frequencies is generated from the document itself, typos in any language can be easily identified by the Bell Labs program.

Telephone "watchdog" increases efficiency

Sophisticated new equipment recently placed on the market may discourage personal calls at company expense, says an article appearing in a recent issue of "Investment in Tomorrow," a quarterly publication of Stanford Research Institute (SRI).

Designated TACS (Telephone Accounting and Control System), the system is essentially a computerised "watchdog" aimed at minimising unauthorised calls and maximising efficiency on the line. According to figures cited in "Investments in Tomorrow," companies typically spend between 10 and 30pc of profits on telecommunications, 60pc of which goes in long distance calls. One company, says SRI's Michael Korek, cut down employee telephone abuse and saved 40pc of its toll charges simply by displaying a TACS in an office lobby to publicise the system's forthcoming installation.

For monthly toll bills of $5,000 or more, passive systems that simply monitor the lines and provide traffic and billing information can provide net savings of 10 to 25 percent, according to the article. When monthly toll bills amount to over $10,000, the article adds, nett savings of 10 to 30 percent can be realised by so-called "active" systems that perform additional control functions such as least-cost routing of outgoing calls. Prices of the systems range from less than $10,000 for the passive type to over $100,000 for the active type.

TACS usually consists of computer-type hardware on the user's premises that records such information as the calling extension, when it went off the hook, the number called, the trunk line used, and when the call was completed. Such a system provides periodic printouts of stored data, sorted into traffic and billing information by the data processing centre. In addition, some systems have teletypewriters that provide immediate printouts on command. Active systems include hardware that controls outgoing lines.

Japanese production costs escalate

Production costs and sales prices of radios and television sets in Japan will top those in the United States for the first time by 1975, according to a survey conducted by the Industrial Bank of Japan. The projection was contained in a report entitled "Internationalisation of Japanese Industries."

Japanese electric appliance and parts makers have been making advances into the US on the assumption that Japan's competitiveness will decline due to Yen revaluation, sharp rises in material costs, and big wage increases, and in this respect the survey endorses such moves.

According to a Bank calculation, Japanese production costs of radios and television sets next will climb by 43.8 percent from the 1970 figure, while in the US the comparable rise will be limited to 13.9 percent due to the effects of the dollar devaluation. This means that 1975 production costs in Japan will be some 2 percent higher than those in the US.

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by ROSS TESTER

In the 3 years since we reviewed the Mecablitz 202, first of the so-called "computer electronic flashes", significant advances have been made in the technology and circuitry used. The Mecablitz 402 Electronic Flash represents the very latest in the field of automatic exposure control.

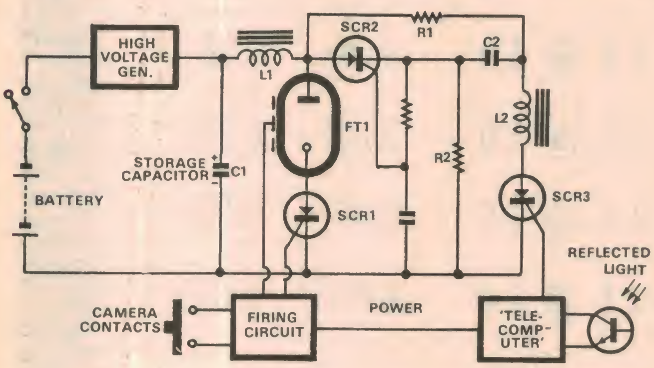
The 402 supersedes the 202, which was the first professional electronic flash put out by Metz using optical feedback to determine flash duration. We reviewed the Metz 202 in the November 1971 issue. At the time, the 202 was the very latest in flashguns, taking the problem of aperture selection out of the photographer's head and solving it in a small "telecomputer" within the flashgun itself.

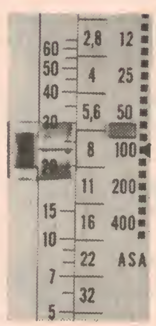
The telecomputer read the amount of light being reflected back from the subject by means of a phototransistor mounted in the handle. This was compared with the f-stop selected by the photographer, and the correct amount of light for that aperture calculated. When this amount was reached, the flash was stopped.

The 202 accomplished this in the only way thought possible at the time. All the energy stored in the capacitor was "dumped overboard". This was achieved by firing

The Mecablitz 402 is a fully automatic flashgun, offering a choice of 5 stops to the photographer. It has a maximum power of 125J, corresponding to a guide number of ??? for 100ASA film.

Below are a much simplified circuit of the flash and a shot of the "Programming Centre" on the rear of the flash handle.





another tube, known as a "quench" tube, which effectively stole all the remaining energy from the main tube so that the latter would extinguish.

Therefore, all the energy stored in the capacitor was used up every time—regardless of the amount of light which came from the unit. Consequently, there was a current drain on the battery which was constant for every shot — and the recycling time, though quite low (3-4-seconds on half power) was also constant.

As we said, the 202 system worked very well — as a matter of fact, I personally have been using a Metz 202 since the original article appeared, in a professional role at the rate of around 500-1000 shots per week. In that period, I would have lost less than a dozen shots because of the flash, for reasons which I will go into later.

But the 402 is better than the 202 — in fact, it could be regarded as the second generation of telecomputer flashes. The 402 does all the things the 202 did, and then some. It calculates the correct amount of light the same way as the 202, but when the flash has been on long enough, the telecomputer stops it dead — not by "dumping" the remaining energy, but by "turning off the tap".

How do you stop a flash half way through? We wondered this too; at first glance it seems very difficult. The 402 has a silicon controlled rectifier (SCR) in series with the tube, and this is used to turn it off. Which sounds fine enough — except that an SCR is not usually used to turn anything off. Rather, it is used to turn something on, by initiating an input to the gate. The SCR then latches on, turning off again only when the anode current and /or voltage falls below the level which is able to maintain conduction.

Here it is used in reverse, which seems to disobey the rules.

Not only that, but the SCR has to handle a peak current of hundreds of amps. When the tube fires, it changes from a virtual open circuit to very close to a short circuit. And a short circuit across a large electrolytic capacitor charged to a few hundred volts means quite a current in anyone's language.

Therefore, the SCR would appear to have everything going against it in this role. But obviously, the Metz engineers have solved the problem, and very successfully — the service technicians for the importers of Metz flashguns inform us that this section of the circuit is one of the most reliable. Naturally enough, with repeated heavy usage, the tubes and capacitors have to be replaced from time to time, but no trouble has been found with the cut-out.

As a matter of fact, practically the only difficulty with the earlier 202 was in this section — the quench tube failed from time to time. Being a flashtube itself, it suffered from the same heat problems asd the main tube, and being in a more confined space, it found difficulty in dissipating the heat quickly.

The flash is actually turned off by commutating part of the flash circuit. Fig. 1 shows a simplified version of the circuit. When the camera contacts are closed, the

ignition circuit actuates both the tube FT1 and SCR1. Storage capacitor C1 discharges into FT1 via L1. This causes the gas in the flashtube to ionize, giving out an intense flash of white light.

The ignition circuit also generates a supply voltage for the telecomputer circuit. This ensures that the telecomputer is actuated only when the flash is fired, thus avoiding false readings due to residual charges, etc.

At this point, the reader may be wondering how the small charge on the quench capacitor manages to override the very high charge on the 2000uF main storage capacitor. This happens because inductor L1 decouples the storage capacitor from the flashtube and the quench circuit.

Actually, this inductor has a dual purpose — when the flashtube is fired, it limits the current to a safe value (thus keeping the current within the SCR dI/dt rating) then, as, we have seen, ensures the cut-out function by effectively isolating the two sections of the circuit. The inductor opposes any change in the current through it, so that the smaller capacitor has time to do its work.

After firing, the quench capacitor is first charged in the opposite polarity by the storage capacitor C1. When the charging current drops below the SCR threshold level, both SCR 2 and SCR 3 turn off (or block). When this happens, C2 re-charges in the original polarity via R1 and R2.

The circuit is then ready for re-firing — and this charge/recharge function occurs during the time the oscillator is recharging the main storage capacitor.

Physically, the Mecablitz 402 is almost identical to the 202. The only difference occurs on the rear of the flash-head handle. There is no half/full power switch on the 402 (its place is taken by an indicator lamp which shows correct exposure) and the power lead socket is slightly different.

When we opened the unit up for a closer look, one of the first sections we looked for was the cut-out circuit and SCR. Believe it or not,we had trouble finding it! In light of what we have said about the duty imposed on the SCR, we thought the SCR would be a massive type mounted on a large heatsink. When we eventually found it (working from a German circuit diagram!) buried under the reflector housing, we were surprised to find a TO-66 cased SCR mounted directly on the printed circuit board!

Another surprise was the inclusion of an SCR in the firing circuit — or rather, the lack of such a circuit in the 202 was more the surprise. When we described how to build an electronic flash back in 1966, we included such a circuit in our model.

The reason for this is simple: most (if not all) flash firing circuits work on the capacitor discharge principle — a capacitor is charged via a resistor from the main high tension supply. This capacitor is in series with the primary of the ignition transformer, and when the capacitor is shorted to the negative supply, the discharge current passes through the transformer. This induces a high voltage (usually 5-10kV) spike across the secondary of the transformer, which is connected to the flashtube.

If the camera contacts are used to short the capacitor directly, quite an appreciable current flows even if the capacitor is quite small. And so, the camera contacts suffer due to arcing and in time burn out.

An SCR in the circuit precludes this. The SCR is used here in the conventional way: it is used to turn on, rather than off. The SCR is placed between the capacitor and negative rail (where the camera contacts would have been). For all intents and purposes, it is open circuit. However, if a small trigger pulse is applied to the gate, the SCR can amplify this, and turns on instantaneously. Because of the amplification involved, the trigger pulse can be made very small — with consequent savings in camera contacts.

The 402 includes this circuitry. It also includes a circuit capable of triggering another flash — or a number of flashes — at the same time. As a companion to the Mecablitz 402, a "slave" flash, the Mecatwin 402, is available. Up to 4 of these slaves can be used with one master unit — thus a whole photographic studio can be built around one of these systems.

Other uses for the Mecablitz/Mecatwin combination lie in effects lighting. For example, with a number of coloured filters made to fit over the front of the flash itself, colour photography results are dramatically improved by highlighting various sections of the picture with various colours. One example of this is the ever-popular "halo" effect made by placing a fixed lamp behind the subject's head and stopping down to allow the light to "spill" around from behind.

Above: The interior of the 402 power pack. Below: These five shots were taken using five different apertures (ie f4, 5.6, 8, 11 & 16) and the telecomputer adjusted light output accordingly for perfect exposures.

This can be done far more easily with a Mecatwin behind the subject — and, if you like, coloured to suit the application. (Blondes look great with a red halo!) And because both slave and master are fully programmable, guesswork is entirely eliminated.

Which brings us to another feature. The telecomputer is mounted in the handle of the flash, pointing forward. In other words, it always faces the same way as the camera. The flash head, while fixed in the same direction, can rotate through 90 degrees vertically for bounce flash, or for flash fill in. Once again, because the telecomputer reads the reflected light from the subject, it doesn't matter how much or how little other light there is. Provided the telecomputer has been programmed correctly, it will read correctly.

This has a bonus for the professional weddding photographer. As most readers will know, at a wedding many people have cameras (particularly since the advent of "instant-load" type cameras) and are often using them at the same time. The odds are (with the fairly long burning time of bulbs) that sooner or later two flashes will coincide. For the professional with telecomputer, everything is "apples". The telecomputer reads all light, and so cuts the tube out quite a bit earlier.

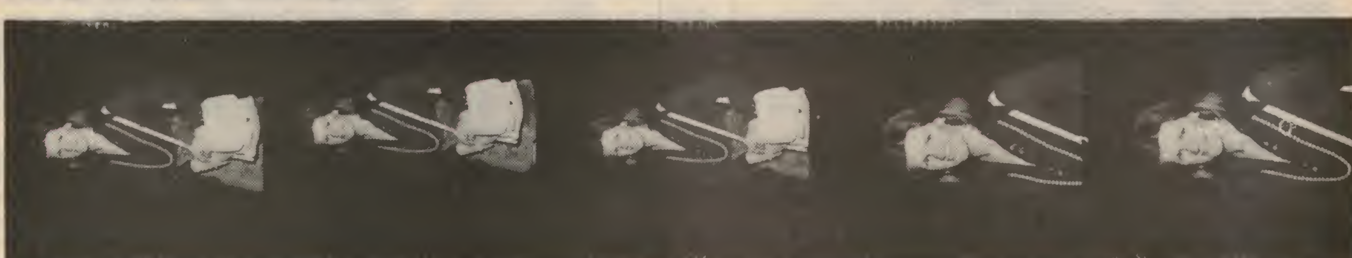
Using the 402 is child's play. Whereas the photographer has to be quite accurate when guessing distances with a conventional flash, it doesn't matter if you can't see past the end of your nose — a pilot light tells you if the aperture selected is adequate for the distance to the subject!

To take a picture, all one does is set the ASA slider to the filmspeed, make a rough guess of the distance, and if the pilot light comes up, all is well. If not, the pointer is set one notch higher (one stop lower) and the test repeated until the light glows.

The camera is then set to the stop shown and, providing all pictures are taken below this distance (down to a minimum of 0.5 metres) they will be correctly exposed.

I mentioned one trap (and it's the only one I've found) which can cause under-exposed negs. This is when the shot is being taken through a door or archway. If one is not careful, light may be reflected from the posts or lintel, giving the telecomputer a false reading. The easiest way to overcome this is to use the flash on manual for this type of photo.

The Mecablitz 402 carries a recommended retail price of $253 and comes complete with a lead-acid battery, camera bar and sync. lead. Further information on this, and other flashguns in the Metz range is available from the Australian agents, Rudolph Gunz Pty Ltd, 63 Ann St, Surry Hills. NSW 2010.



Simple AF oscillator uses two low cost ICs

Here is the design for an easy to build audio oscillator which uses only two low cost ICs. It generates both sine and square waves at low distortion, covering the frequency range from 3Hz to 30kHz. You can power it from batteries, or from a simple mains supply.

by IAN POGSON

Looking through a recent edition of "Radio Communication," my interest was aroused by a very simple Wien bridge oscillator circuit by D. S. Jones. The circuit uses the ever popular and very low priced type 741 IC op amp. The supply suggested is 12 volts and the current just a few milliamps. Tuning is by a ganged 10k potentiometer and the frequency coverage is from 3Hz to 40kHz in four ranges. This looked like a good starting point for a low cost, simple, yet very worthwhile, economy audio oscillator.

Having seen the above circuit, I then recalled that a Schmitt trigger using a 555 timer IC was given in Circuit & Design Ideas (May, 1974). This could be used with the Wien bridge audio oscillator to provide square waves in addition to the normal sine wave output.

By rearranging some of the time constants in the Wien bridge, the frequency coverage could easily be changed to go from 3Hz to 30kHz in four ranges. Instead of a 12V DC supply, this has been increased to 15V and could even be increased further to 18V. Hopefully, the increase in supply voltage would reduce the harmonic distortion to some degree.

As this audio oscillator set out to be an economy unit, a fairly obvious saving would be to do without a level meter. However, by taking some other quite inexpensive steps, the output voltage may be determined with quite good accuracy without the use of a meter.

The sine wave output is over one volt and by adding a preset potentiometer in series with the output load, the voltage across the load could be adjusted to one volt against a suitable meter. As the output voltage is almost constant over the entire range, it is then only necessary to provide a means of voltage division and the output voltage can be attenuated by a known amount.

By suitable switching, the sine wave output can be put through a type 555 IC used as a Schmitt trigger to give a square wave output. As the output of this stage is also in excess of one volt, the same procedure has been adopted to reduce the output to one volt and this is attenuated in the same way as for the sine wave output.

The oscillator circuit is the Wien bridge and for those unfamiliar with this arrangement it is shown in principle in Fig 1. As may be seen it consists of a high-gain differential amplifier with two separate feedback circuits. One circuit, consisting of resistors R1 and R2 and capacitors C1 and C2, connects from the amplifier output back to the "+" input and so provides positive feedback. The other circuit consists of resistor R3 and the thermistor (negative temperature-coefficient resistor), and is connected between the output and the "—" input to provide negative feedback.

The configuration R1, R2, C1 and C2 is known as the "Wien network". At a particular frequency determined largely by the values of the four elements, the transmission loss of the network falls to a minimum while the phase shift also passes through zero.

If R1 and R2 are equal in value, and C1 and C2 also equal in value, the frequency of oscillation is equal to the reciprocal of 2piRC. Under these conditions, the transmission loss falls to a minimum of 3. In other words, there is a maximum transmission gain of 0.33.

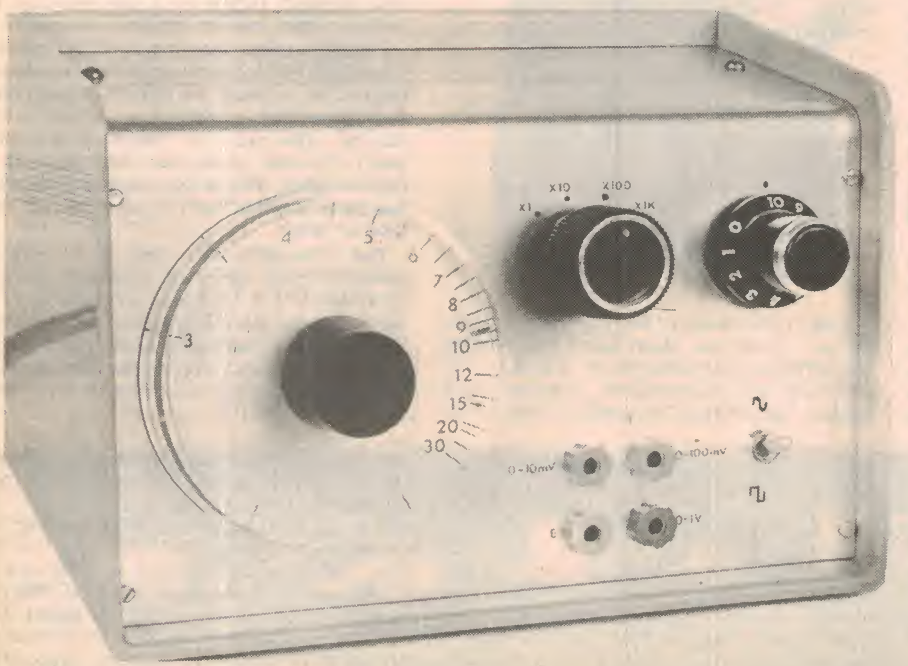
To produce sustained oscillations, the overall loop gain must be at least unity and the phase shift either zero or a multiple of 360 degrees. For the circuit of Fig. 1 to produce continuous oscillations, the amplifier gain must be at least 3 to compensate for the loss in the Wien network.

It is necessary for the amplifier to have an overall loop gain of at least unity for sustained oscillations. But if the gain is more than one, the oscillations will continue to grow until the amplifier is driven into clipping. To keep the gain at unity and oscillation at constant amplitude, a thermistor is used in the negative feedback network.

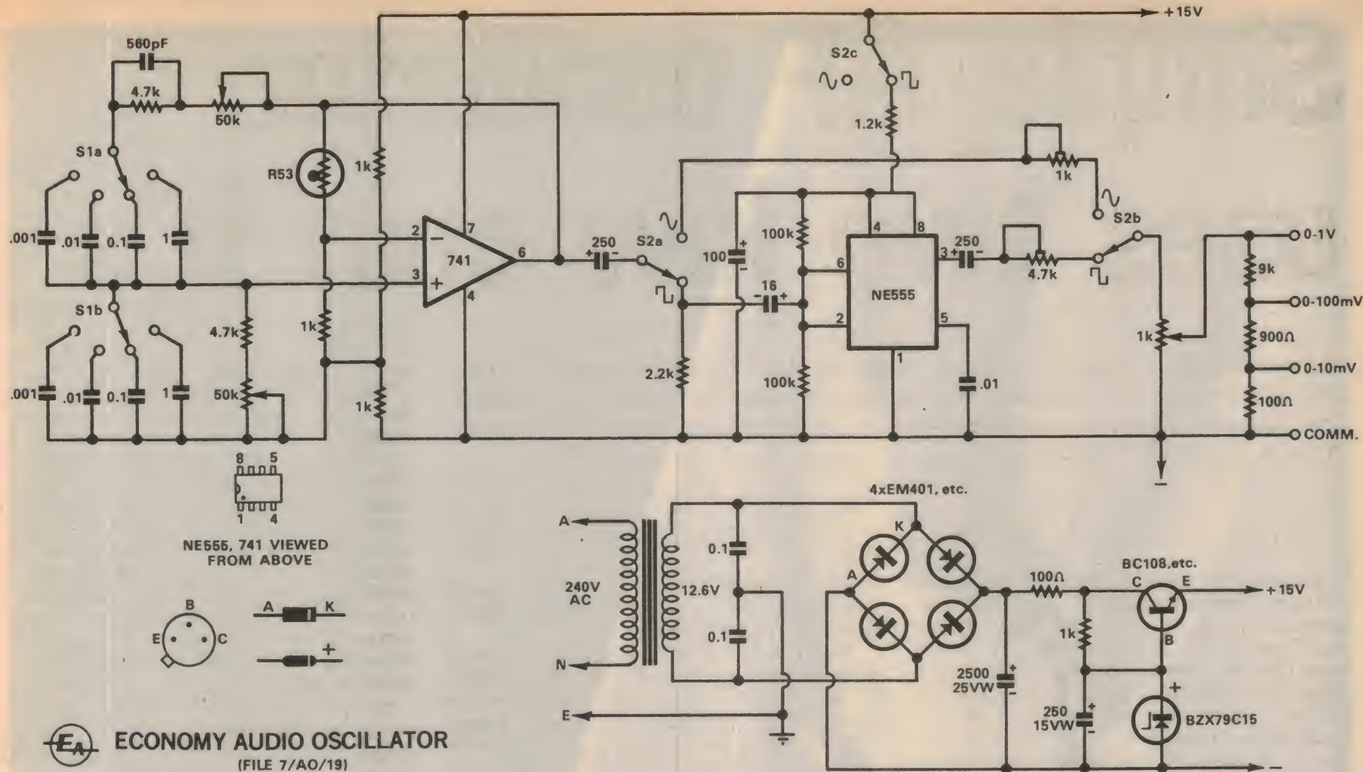
Since the thermistor has a negative temperature coefficient of resistance, its resistance falls as its temperature rises. When power is first applied to the circuit the thermistor will have a relatively high resistance and so there will be little negative feedback. The resulting high gain around the positive feedback loop will rapidly build up oscillation.

As the oscillations grow, the temperature of the thermistor rises, as this and resistor R3 are effectively connected in series across the amplifier output and so draw signal current. Hence the resistance of the thermistor falls, negative feedback increases and the effective amplifier gain drops.

Consequently an equilibrium is reached, as the output amplitude can only rise to the point where the thermistor has increased the negative feedback to correspond to an effective gain of three — giving unity loop gain. If the oscillations tend to rise above



Above is the completed prototype housed in a plastic case.



The circuit of our economy audio oscillator uses two low cost ICs and offers low distortion.

this level, the thermistor will reduce the loop gain and the oscillations will begin to die away. Conversely, if the amplitude tends to fall, the thermistor will increase the loop gain slightly above unity to correct it.

In short, the non-linear negative feedback action produced by the thermistor acts to continuously and automatically maintain the loop gain at unity, and the oscillation amplitude constant. By using a suitable thermistor the output amplitude may be maintained at a level well below limiting, giving an output waveform with low distortion.

Looking now at the main circuit, the relative parts may be clearly seen with reference to the foregoing description of the theoretical aspects of this type of circuit. The positive and negative feedback circuits are easy to see, along with the two resistors and capacitors for each frequency range. Before leaving the oscillator section of the circuit, it may be seen that one of the 4.7k resistors is shunted with a 560pF capacitor. This is to compensate in some measure for stray capacitance in the circuit, which becomes significant at the higher frequencies.

The oscillator circuit is followed by a Schmitt trigger which can be used to convert the sine wave output from the oscillator to a corresponding square wave. The Schmitt trigger uses a type 555 timer IC as suggested by Walter G. Jung and the circuit performs this task adequately.

In order to select either sine or square wave output, a three-pole two-position toggle switch is used. This diverts the sine wave either through or around the Schmitt trigger. At the same time, the positive supply rail is switched on or off in accordance with the requirements of the Schmitt trigger.

Whichever output is selected, it is fed into a 1k linear potentiometer. Before being fed into this potentiometer, it is passed through a variable resistor in the form of a preset pot, which is set to give a predetermined output level. More will be said about this later on. To give a wider range of control over the output level, the output of the 1k pot is fed into a voltage divider. The divider provides for divisions of 1, 10 and 100, corresponding to attenuations of 0dB, 20dB and 40dB, respectively. In addition, the 1k pot is fitted with a knob calibrated 0 to 10, which means that attenuation may be achieved fairly accurately down to 60dB.

With the preset pots just referred to adjusted so that we have a level of one volt across the 1k pot, we are able to make settings between 0 to 1V, 0 to 100mV and 0 to 10mV. We may therefore set the output level fairly accurately anywhere between 1mV and 1V.

We elected to incorporate a power supply within the unit, although it would be quite possible to run it from batteries. The power supply is regulated at 15V and although it is a simple circuit, steps have been taken to keep hum and noise to a minimum.

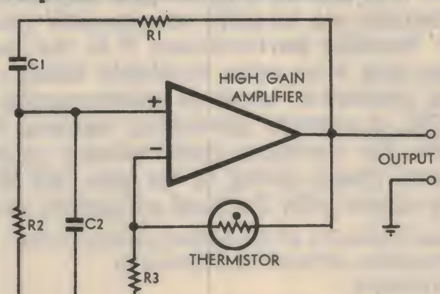


Figure 1

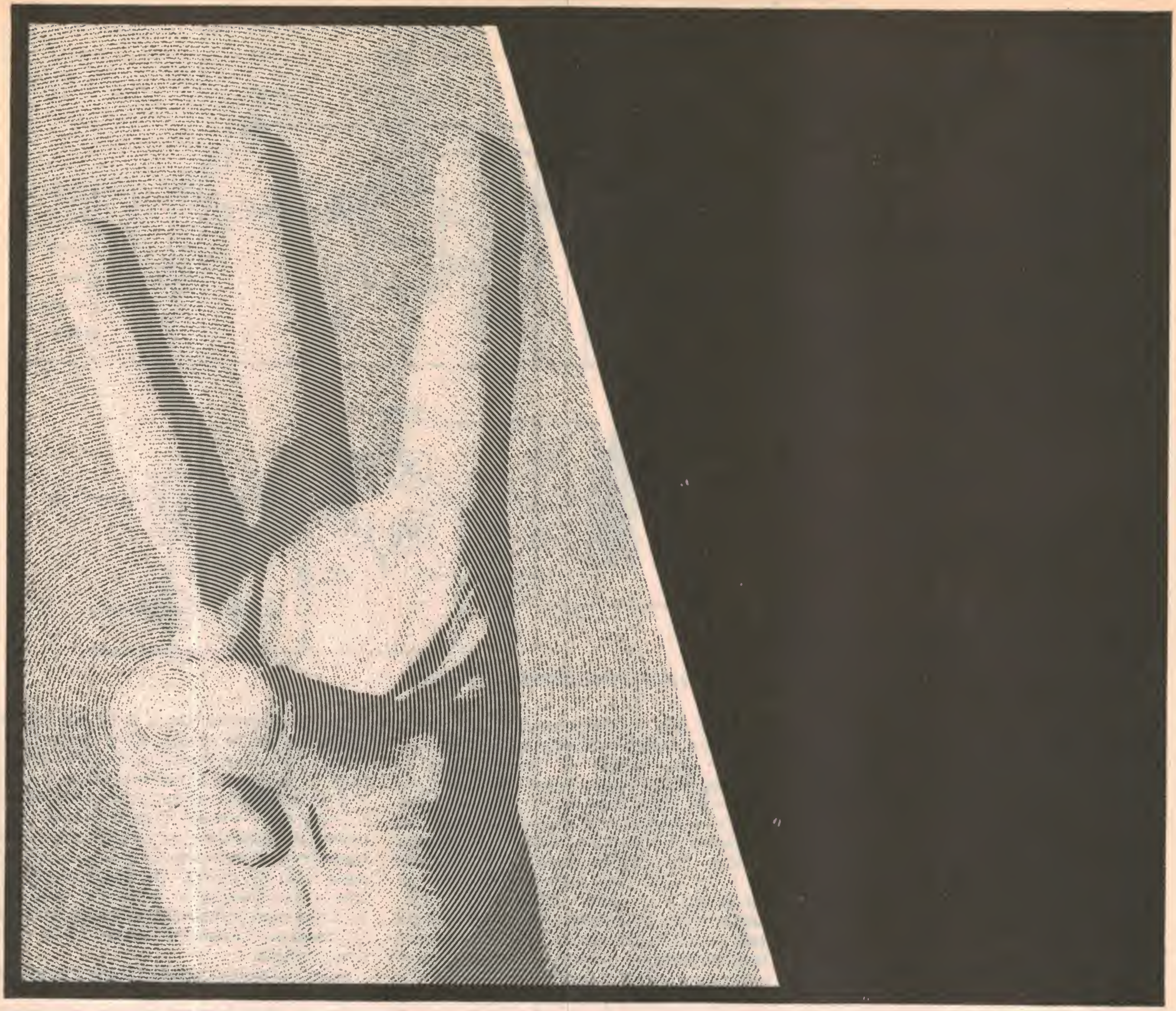
Above is the schematic of a Wien bridge oscillator showing the high gain amplifier and its associated positive and negative feedback networks.

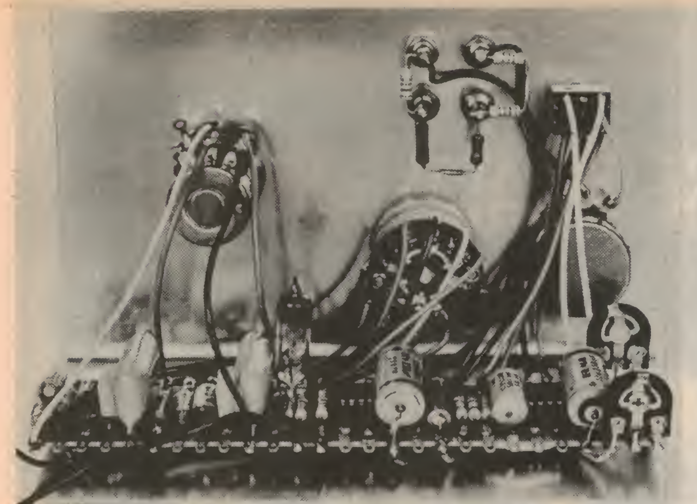
The transformer has a 12.6V secondary winding rated at 150mA. Four diodes in a bridge give about 18V DC across the 2500uF filter capacitor. A BC108 transistor is used in a simple series regulator circuit which is referred to a 15V zener diode in its base. The two 0.1uF capacitors, one on each side of the secondary of the transformer help to reduce noise from the mains. The negative supply line is left floating as is normal practice with this type of instrument. Metal parts of the case are connected to the mains earthing system.

Some comments on the more important components may be helpful. Perhaps the item of most interest is the 50k linear ganged potentiometer. In the interest of economy, we used an imported deposited carbon unit under the name of Soanar. This has proved to be quite satisfactory; we have tried a number of them in the circuit and each one follows the calibrations well enough for all practical purposes. For readers who decide to use this potentiometer, we are printing a full size copy of the scale which may be used in any way that is considered best. We are not in a position to provide any other form of this scale for this particular project.

Before leaving the subject of carbon potentiometers, we can see no reason why some other brands of potentiometer should not be tried. However, it may be that the scale which we have calibrated against the Soanar unit may not suit another brand. In this, and other circumstances yet to be touched on, it would be necessary to calibrate your own scale.

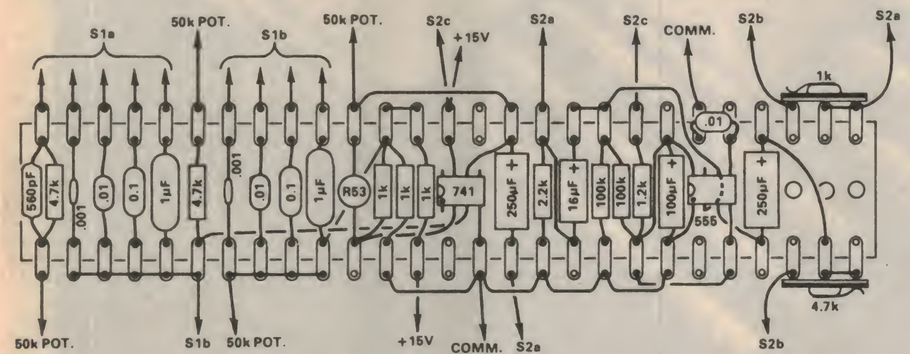
When considering what potentiometer to use initially, we investigated the idea of using a moulded carbon unit but as near as we can ascertain, these are not available in the type and resistance value required. In past projects we have used a wire wound potentiometer, made by Naunton. These are still available and may be used if any

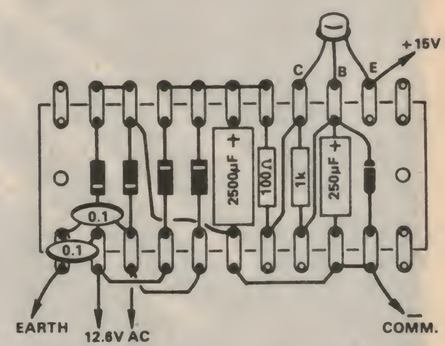




This view shows the simple wiring layout behind the front panel. Note that the panel is earthed through the mains wiring.

Above is a view inside the plastic case showing details of the power supply layout. The unit may also be powered from batteries.





These two wiring diagrams should make construction a straightforward process. The oscillator tagboard is shown at left, whilst the simple regulated power supply is shown at right. Make sure that the thermistor is firmly secured in position.

reader so desires. However, there are two points worth considering. It would be necessary to calibrate your own scale, and the price could be rather daunting. The choice of course is up to the individual.

The output level control is a 1k moulded carbon potentiometer in the prototype. While an ordinary carbon pot may be quite satisfactory, we considered that the moulded element would be more reliable from a linearity point of view. This is important as we have fitted a knob to this control which is calibrated 0 to 10. This facility, in conjunction with the output divider, makes it possible to set the output level with reasonably good accuracy.

The output divider just mentioned is made up of a number of resistors to give the correct ratios. The bottom element is 100 ohms and this presents no problem as it is a preferred value. The next section calls for 900 ohms and this is made up with 220 ohms and 680 ohms in series. The top section has a value of 9k and this is made up with 2.2k and 6.8k in series. We used Philips ½ watt types here and although we did not specify close tolerance, we have found them to be quite satisfactory.

The set of capacitors for the frequency ranges should be of good quality and preferably of 1 percent tolerance. The tolerance applies to all except the 1uF. Although it would be ideal to have this in the same tolerance, it would be quite expensive and we understand that availability is open to question. We found that with 10 percent tolerance units in circuit the amount of error was not significant for normal purposes.

The thermistor is an STC type R53 and this does an excellent job in this circuit. While we have not tried other types, we feel that it would be wise not to substitute for this item.

Both ICs are readily available. The type 741 comes in a number of brands but the 555 IC timer is only available from Signetics. Both ICs are 8 pin DIL as used in the prototype but other packages are also available if required. For our purpose, the smaller package is more convenient.

The prototype was built into a plastic case with an aluminium front panel and one which we have used a number of times before. This case comes from the Australian Transistor company, Mount Waverley, Victoria and it is distributed in NSW by Watkin Wynne Pty Ltd, 32 Falcon Street, Crows Nest.

Most of the components are mounted on either one of two miniature tag boards and these are shown in diagram form. Care should be taken with the thermistor to stabilise it mechanically and this may be done by simply tying or gluing it to the adjacent 1uF capacitor. Sockets for the two ICs are fixed to the board by drilling eight holes on the board carefully with a fine drill. Lugs of the sockets are pushed through the board and leads taken as shown in the diagram. The photographs show the location of all major components. The boards are stood off the case by 5mm or so by means of spacers, or by using a couple of extra nuts on each of the mounting screws.

The power transformer which we used had a centre tap on the secondary winding, but this is not required. We simply cut it off to about 10mm long and located it so that it was not likely to come into contact with any other parts of the unit when it was all assembled. A lead which should not be forgotten is from the mains earth termination to a lug on the metal front panel.

Once the unit is assembled it is ready for adjustment and calibration. Before going ahead with these operations, a simple check that it is working would be in order. Feed the output into a CRO or listen on a pair of headphones. If you choose the latter method, make sure that the oscillator is operating at a frequency which is covered by the phones in use. Assuming that you get sine waves and square waves on the CRO, or sounds resembling a flute with the switch in the sine wave position and sounds like a clarinet when the switch is in the square wave position, you are in a position to carry out adjustments.

Set the dial knob assembly on the potentiometer spindle such that the pointer corresponds with the marks on the scale for extreme limits of travel. Set the output knob on the output pot spindle so that 0 and 10 correspond with minimum and maximum output, respectively.

Set the range switch and frequency dial to give an output of about 100Hz. Set the output level control to 10 and take the output from sockets "E" and "0-1V" and connect to an AC voltmeter of good accuracy and high

impedance. Set the toggle switch to sine wave output and adjust the 1k preset pot to give a reading of 1 volt. Set the toggle switch to square wave output and adjust the 4.7k preset pot to give a reading of 1 volt.

If you have access to a calibrated CRO, the two preset pots just mentioned may be set against the CRO graticule. For sine wave output, the level should be set to give a reading of 2.8V peak-to-peak and for square waves, a reading of 2V peak-to-peak should be obtained.

If you have used the same type of 2-gang potentiometer as for the prototype, together with a copy of our scale, then you will not have to carry out any further calibrations. For readers who have used the wire wound, or some type of pot different from that on the prototype, then it will be necessary to calibrate the frequency scale. Whatever method is used, it will only be necessary to calibrate for one range. This could conveniently be from 30 to 300Hz, with the range switch set to "X10".

If you are fortunate enough to have access to a digital frequency meter, then the job may be done quite easily. Another method is to generate Lissajous figures with the aid of an oscilloscope and another known source of audio frequency. The second source could be an accurately calibrated oscillator, a test record, an electronic organ or the mains frequency of 50Hz.

For those not familiar with the Lissajous figure method of frequency comparison, the following briefly outlines the procedure. The output of the known frequency source is fed to the horizontal amplifier of the CRO and the output of the oscillator to be calibrated is fed to the vertical amplifier. When the gains of the two deflection amplifiers are suitably adjusted, a series of patterns known as Lissajous figures are produced. Typical frequency patterns are shown. These enable the unknown frequency to be calculated easily.

These figures differ from the normal pattern produced by a sine wave oscillator, since the horizontal deflection signal is a sine wave and not the normal sawtooth produced by the oscilloscope timebase generator.

Some examples of Lissajous figures are shown in Figure 2a. Each represents a different frequency ratio — 1:1, 2:1 and 3:1. Each ratio is that of the vertical frequency to the horizontal frequency. If the signal applied to the horizontal amplifier is 50Hz and the resulting ratio is 2:1, then the vertical frequency will be 100Hz.

The method of determining the ratio is to count the loops along the top of the pattern and the number of loops along one side. The ratio of the two numbers is the frequency ratio.

This basic rule makes it possible to identify a variety of ratios. For example, five loops along the top and two at the side would indicate a ratio of 5:2 and, related to 50Hz, this would indicate a frequency of 125Hz. Incidentally, submultiples can be identified in the same way and Figure 2b indicates the pattern shape for ½ and 1/ 3 of 50Hz, corresponding to 25Hz and 16.7Hz.

If you attempt to simulate these patterns on a CRO you will find that the patterns tend to drift. This is because the phase relationship of the two frequencies is changing because of small frequency drift of the two sources. Unless the two sources are very stable, the circle pattern will slowly change to an ellipse to a straight line as the phase relationship of the two signals changes. A circle represents a phase difference of 90 or 270 degreees while a straight line represents a phase difference of zero or 180 degrees. This drift in the pattern is only a portion of a cycle and so it has negligible effect on calibration accuracy.

The foregoing information on Lissajous patterns may be used to calibrate your oscillator and this may be applied most easily to the range 30 to 300 Hz, as mentioned earlier. Once you get the easy points, such as 50Hz, 100Hz, 150Hz, etc, other intermediate and less obvious patterns will become obvious by virtue of interpolation of the already determined points. It is not a difficult operation and indeed, can be quite fascinating.

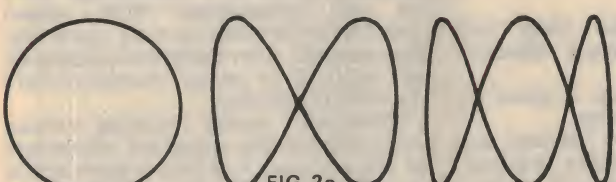


FIG. 2a

These Lissajous figures show (left to right) vertical to horizontal frequency ratios of 1:1, 2:1, and 3:1.

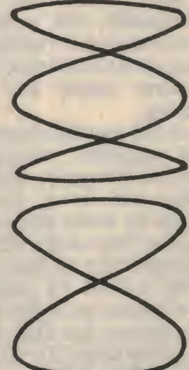


FIG. 2b

These Lissajous figures show vertical to horizontal frequency ratios of 1:3 (top) and 1:2 (bottom).

At left is the dial scale reproduced actual size.

LIST OF COMPONENT PARTS

- *1 Case 184mm x 115mm x 118mm, with aluminium front panel (Aust Transistor Co)*
- *1 Transformer, 240V primary, 12.6V secondary at 150mA. PF2851 or similar*
- *1 50k linear dual-ganged potentiometer, Soanar (see text)*
- *1 1k linear moulded carbon potentiometer*
- *1 2-pole 4-position rotary switch*
- *1 3-pole 2-position toggle switch*
- *4 Banana sockets, 1-black, 3-red*
- *1 3-way terminal strip*
- *1 Jabel handspan knob for frequency scale*
- *1 Scale (see text)*
- *1 Knob with indicator dot for range switch*
- *1 Knob calibrated 0 to 10 for 1k pot*
- *1 Tagboard with 27 prs tags*
- *1 Tagboard with 11 prs tags*
- *4 Diodes, EM401 or similar*
- *1 Zener diode, BZX79/C15*
- *1 Transistor, BC108 or similar*
- *1 IC, 8-pin DIL 741*
- *1 IC, 8-pin DIL 555*
- *2 8-pin DIL IC sockets*
- *1 1k linear trimpot*
- *1 4.7k linear trimpot*
- *1 Thermistor, STC type R53*

RESISTORS (½ or ¼ watt)

- *2 100 ohms*
- *1 220 ohms*
- *1 680 ohms*
- *4 1k*
- *1 1.2k*
- *2 2.2k*
- *2 4.7k*
- *1 6.8k*
- *2 100k*

CAPACITORS

- *2 .001uF 630V polystyrene, low tolerance*
- *2 .01uF 630V polystyrene, low tolerance*
- *2 0.1uF 100V polycarbonate, low tolerance*
- *2 1uF 200V polycarbonate (may be low tolerance if available)*
- *1 .01uF 25V redcap*
- *2 0.1uf 100V polycarbonate*
- *1 16uF 40VW electro*
- *1 100uF 12VW electro*
- *2 250uF 12VW electros*
- *1 250uF 15VW electro*
- *1 2500uF 25VW electro*

SUNDRIES

3-core flex with 3-pin plug and flex clamp, screws, nuts, spacers, hookup wire, solder.

The Heathkit AM/FM stereo tuner model AJ-1214. Styling features wood end cheeks, black vinyl top, chrome knobs and trim, and black perspex dial with illuminated green scale. The word STEREO appears in red when a pilot tone stereo signal is being received.

A Typical AM/FM Tuner

With the reintroduction of experimental FM broadcasting in Sydney and Melbourne, it is an appropriate time to take a closer look at FM tuner technology. As an example of current practice, we have selected the Heathkit AM/FM Stereo tuner, model AJ-1e14. In fact, if you can spare the purchase price and about 15 hours of working time, you can build one up for yourself. We did just that as a preamble to this article.

by NEVILLE WILLIAMS

Our purpose in this article is partly to draw attention to the kit but, more than that, to illustrate in a practical way the technology behind a modern AM/FM tuner. As such, the article will complement what we have already published, introducing in a general way the subject of FM/stereo broadcasting.

As with a great deal of other electronic equipment, one cannot be too pedantic about what constitutes "modern" or "typical" practice. There is a steady stream of announcements about new devices — integrated circuits in particular — which offer potentially neater and cheaper ways around technological problems. To mention a few: logic IC's for computers and calculators; chroma decoders for colour TV receivers; 4-channel decoders for quadraphonic hifi systems.

And in the present context: composite IF/detector systems for radio tuners; quadrature detectors; decoders for FM/stereo multiplex.

Not all the devices heralded with great gusto actually make the production line; they turn out to be unreliable, or commercially unattractive; or they are superseded in short order by something different or better!

As a result, equipment manufacturers face a constant dilemma as to how long to stay with established and proven technology, or how soon to take up something that is, as yet, unproven but potentially attractive — technically and commercially. To examine tuner and receiver design is to discover different reactions to this dilemma.

The Heathkit AJ-1214 tuner is about as typical as any one unit can be.

It covers the medium-wave AM band and the full FM band from just below 88 to just above 108MHz, with automatic stereo decoding when it senses the presence of a pilot tone sub-carrier. Though integrated mechanically, the sections are virtually separate superhet tuners, intended to work with separate antennas. They merge only at the power supply and the audio output switching.

Each follows the classic superhet pattern of RF amplifier, frequency changer, IF amplifier, detector and audio output. In function and detail, however, they could scarcely be more different.

Looking first at the FM side, signal input would normally be from a VHF FM aerial, or from a VHF TV aerial designed to include frequencies in the FM band. Heathkit do not favour the idea of an FM receiver sharing the same aerial as a TV receiver, unless the installation is properly planned. Isolation must be provided but passive, resistive pads should only be considered, they say, where there is no risk of the resulting signal loss prejudicing the signal/noise ratio.

In any case, directive aerials are much to be preferred to makeshift arrangements or gadgets that sit on top of the cabinet. Just as multipath transmission can cause ghosting effects in television pictures, so can a confused input signal prejudice the ultimate quality and definition of FM/stereo multiplex.

Provision is made in the tuner to accept the signal via either 300-ohm twin lead or 75-ohm coaxial cable, depending on the installation.

Front-end tuning involves three segments of a composite AM/FM 6-segment capacitor, driven by a conventional drum and cord arrangement. While ganged capacitor tuning takes up more space than other methods, it is reliable and predictable and utilised by many manufacturers wherever practicable.

"Electronic" tuning involving varicap semiconductors has undoubted advantages but there is more to it than a mere circiut arrangement. Very tight control has to be exercised over the components if the capacitive elements are to "track" with the predictability of a well-engineered mechanical system. It is one of the more recent developments which has yet to become entrenched.

RF amplifier in the Heathkit tuner is a FET of unspecified type, operating with tuned input and output and with AGC voltage applied to the gate. The use of a single RF stage is appropriate for all normal needs and yields figures (IHF) of sensitivity 2uV and image rejection 50dB. In prestige models, manufacturers commonly provide more elaborate front-end tuning in an effort to secure the best possible noise and interference immunity, particularly for resolving weak stereo signals. Obviously enough, additional circuitry means additional cost.

An NPN transistor (type not specified) is used as a mixer feeding into a double tuned IF transformer and thence into the IF system.

Another NPN transistor serves as the local oscillator, in a grounded base configuration. While nominally tuned 10.7MHz above the incoming signal frequency, the

oscillator is subject to automatic frequency control applied via a varicap diode connected across the oscillator-tuned circuit. Fed with a control voltage from the detector circuit, the shunt diode seeks to maintain the IF signal at a constant frequency at the detector, combating automatically errors or drift in tuning.

All these details are derived from the schematic circuit and do not concern the constructor of the Heathkit in the ordinary way. The entire VHF circuitry is contained in a pre-assembled tuning box which is installed in much the same way as a TV tuner and provided with the appropriate input, output and supply leads. The assembly is secured to the main wiring board after all the other work has been completed.

The IF system of the FM tuner operates at 10.7MHz, which is virtually a world standard figure. Here the influence of modern technology is evident. Instead of a string of valves, or even of discrete transistors, with peripheral supply and gain control circuitry, most of this has been compressed into a single integrated circuit package — an M7338.

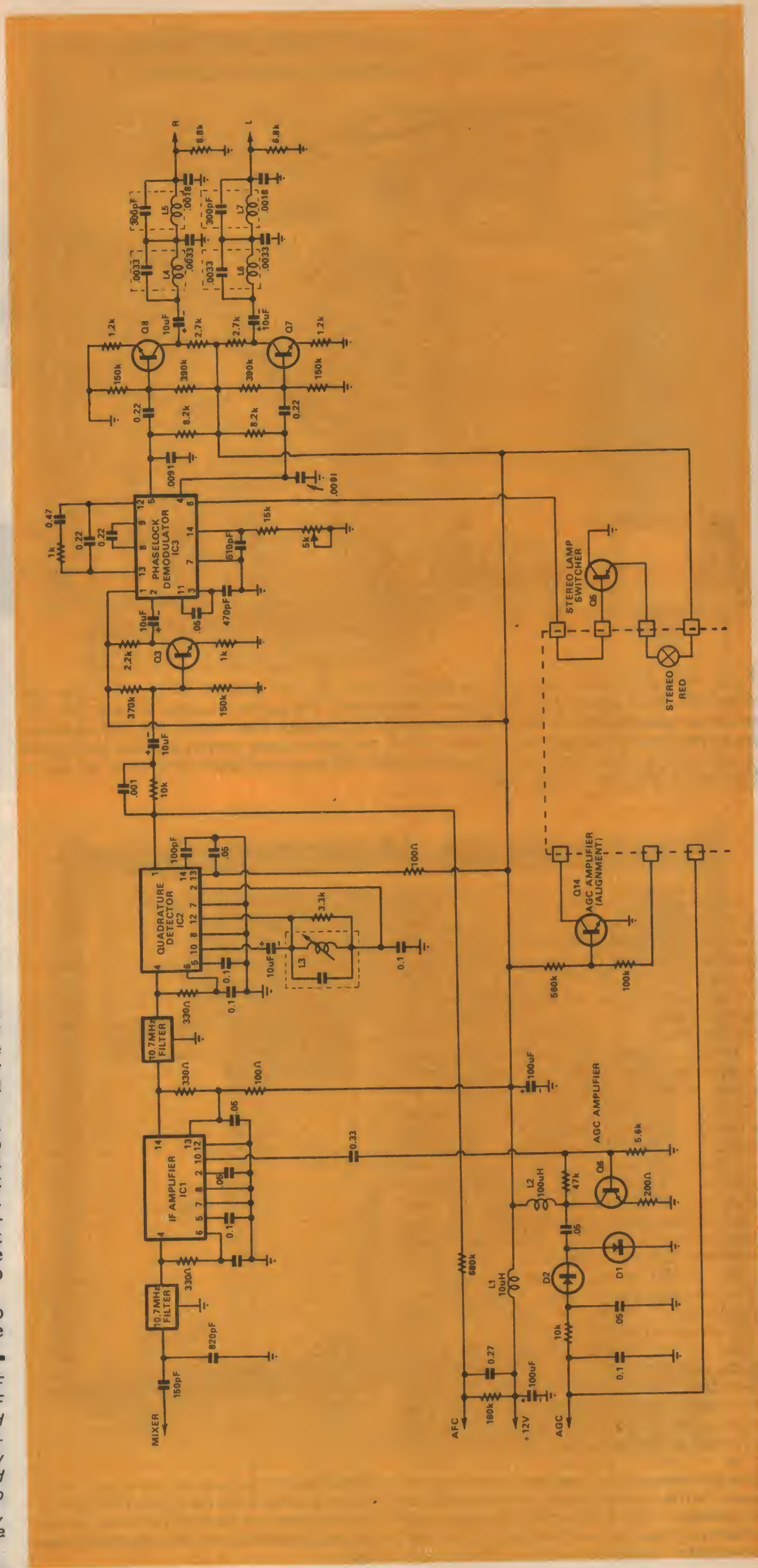
This IC operates in conjunction with two pre-matched ceramic filters, one at the input and the other at the output of the device. Not only do the ceramic filters obviate the need for a series of critically aligned tuned circuits but they provide a highly satisfactory bandpass characteristic with good phase linearity across the pass band.

So the signal from the mixer passes through the coupling transformer and input ceramic filter to the IC. There are two outputs from the IC, from pins 1 and 14. The IF output signal from pin 1 is amplified by an NPN transistor (2N3393) and applied to two 1N4149 silicon diodes which generate the AGC voltage for the FET RF amplifier.

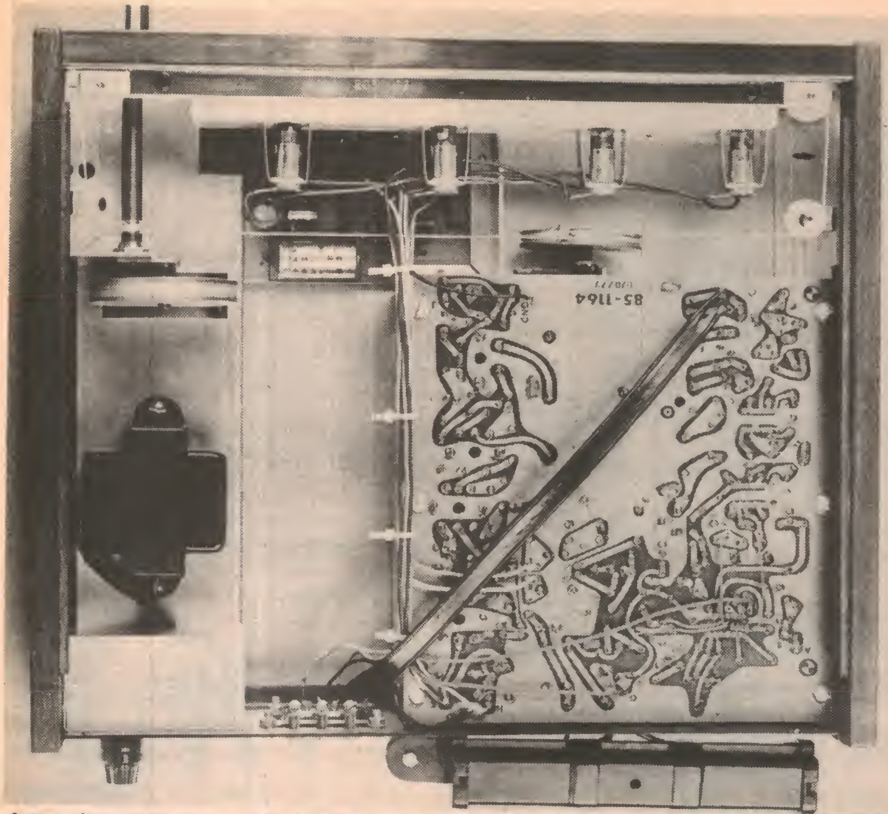
The second output, from pin 14, has been clipped or "limited" by the M7338 IC to remove all amplitude variations of the signal. This output passes through a ceramic filter to the input, pin 4, of another M7338 IC which functions as a quadrature detector. For this role it is necessary to take the output from pin 10 and feed it back into pin 12 with a fixed phase delay, as provided by a small can mounted inductor shunted by selected values of R and C. The ultimate output from pin 1 of the quadrature detector is a voltage proportional to the signal deviation.

This may be a relatively straightforward modulation component in the case of a mono FM station. It may be anything but straightforward for a stereo/multiplex station with an SCA channel superimposed. Then the modulation components will include main channel FM 50Hz to 15kHz; pilot tone 19kHz; suppressed carrier difference signal 23 to 53kHz; SCA components 60 to 74kHz.

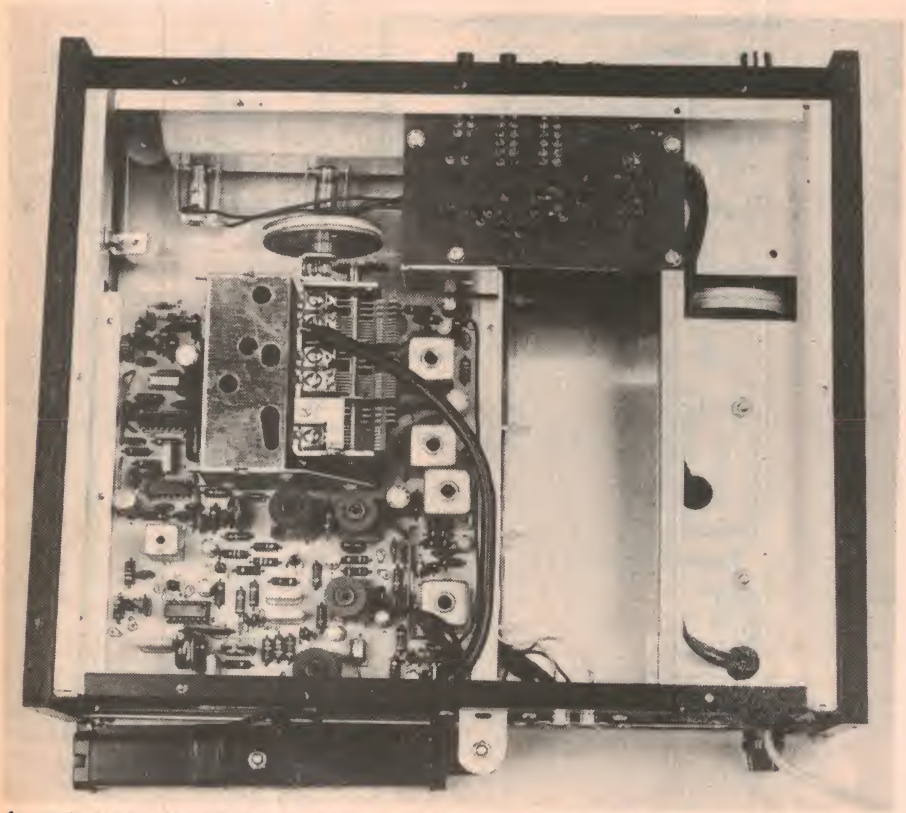
But, straightforward or complex, two components are extracted from the



The circuit diagram of the 10.7MHz IF channel of the Heathkit tuner. The VHF front end is a separate pre-fabricated assembly, while the AM section is an entirely conventional design using ordinary discrete transistors. The transistor marked AGC Amplifier (Alignment) is bridged into circuit only for the FM alignment procedure, playing no part in ordinary operation of the tuner.



A top view of the tuner. Most of the mains wiring, the fuse and the RF filter is under the protective cover adjacent to the power transformer. The actual circuitry for the 12V DC supply is concentrated on the board below the dial, which also carries the push-buttons. Separate AM and FM superhet tuners are on the main board, which mounts with components down. Twin ribbon carries signal to the FM tuner, while the ferrite rod for AM is attached to the rear of the chassis.



An underneath view of the tuner showing the components on the main circuit board. Most prominent item is the actual tuner assembly which is self-contained as far as the VHF circuits are concerned. The FM section begins at the left of the tuner, as viewed, with the decode and filter components at the bottom. The AM tuner runs straight down the right hand edge of the board, being an entirely conventional design.

modulation. One network involving a 680k resistor followed by capacitance forms a low pass filter which eliminates the RF and audio components and leaves only a DC voltage which varies in amplitude and polarity, depending on whether the IF signal is symmetrical in relation to the detector cross-over frequency. It is this DC voltage which is applied to the varicap shunting the oscillator tuned circuit to provide the automatic frequency control, mentioned earlier. A preset pot on the board allows the amount of control to be adjusted as necessary.

A second network from pin 1 of the quadrature detector IC couples AC signal components to a 2N5294A NPN transistor stage with a gain of about two and a reasonably low output impedance to feed a third IC, type M7332.

As indicated earlier, the modulation components at this point can be an extremely complex mix and sorting them out has, to date, involved a considerable amount of complex and critical circuitry. It still does, except that Motorola have concentrated it all in one integrated circuit package intended to serve as a phase-locked demodulator. In their manual on the tuner, Heathkit do not attempt to enlarge upon its operation. They provide the quite ordinary peripheral components and simply suggest to the constructor that he consult Motorola's own literature if he wants to know what goes on inside the tiny black package.

The fact is, however, that the M7332 is the heart of this and many other FM/stereo tuners. It accepts the total modulation and proceeds to demodulate the difference subcarrier to recover the L-R component superimposed on it. It combines this internally with the main modulation (L+R) component received from the detector to produce the original stereo pair, L and R, which appear at output lugs 4 and 5 with a separation of between 35 and 40 dB — at least as far as the receiver is concerned. At this point, bypass capacitors impose the appropriate treble attenuation — or de-emphasis.

In addition to its main role, and as a by-product of its operation, the M7332 provides a signal which can be applied to light a panel lamp whenever a pilot tone is present, indicating that the tuner is operating in stereo mode.

From the demodulator, the L and R signals pass to two 2N5232A transistors which provide low impedance output to the external amplifiers. (In Heathkit's schematic one is wrongly shown as an emitter follower). In series with each output is a two-section LC filter intended to remove components above 15kHz but particularly at 19kHz (the pilot frequency) which can interact with the bias oscillator in tape recorders to produce audible whistles.

No provision is made in the Heathkit tuner — nor in any ordinary tuners and receivers — to recover the SCA signal, if broadcast. This, in fact, requires an alternative approach aimed at recovering the SCA modulation and rejecting the main FM program.

Compared with the FM section, the AM section is relatively straightforward. Signals are picked up by a generously proportioned loopstick aerial which one has to assemble (rather gingerly) into a plastic housing. It attaches to the rear of the tuner and would add to its depth quite a lot but for the fortunate fact that it can normally be tucked quite close to the back of the cabinet.

One unusual aspect of Heathkit's loopstick aerial is that there is no provision to vary its inductance. This makes it necessary to peak the RF and oscillator coils to the loopstick, setting the dial pointer also to suit it at the low frequency end of the band. Trimmers, of course, provide the necessary adjustment for the high frequency end.

Otherwise the AM section follows along conventional lines: An NPN transistor serves as an RF amplifier, coupling through a tuned RF circuit to another transistor serving as a self-oscillating mixer. Then follows a double-tuned and tapped 455kHz IF transformer feeding a neutralised IF stage. This feeds through a single tuned transformer into a germanium diode, providing detection and simple AGC back to the RF and IF stages.

A common emitter amplifier stage provides a suitably low output impedance to service the switching circuitry and the cable connections to the main amplifier. No whistle filter is provided, indicating that the designers have not thought it likely that adjacent channel signals would get through the entirely conventional pass band.

In fact, as with most AM/FM tuners, the AM section is a conservative and "safe" design which will give a reasonable account of itself around the broadcast band in terms of logging ability, and receive local stations clear of interference, even if they do sound conventionally somewhat "mellow"!

The power supply is also fairly typical of current practice. The transformer itself can be wired for either 110VAC or 240VAC depending on whether the primaries are connected in series or in parallel. Three transistors and a zener diode provide smoothing, regulation and overload protection of the DC supply which is 12V.

So much for the electrical design of what is a typical AM/FM tuner — not the most elaborate that money can buy but certainly one that most enthusiasts would be quite happy to own.

BUILDING THE TUNER

What of the kit itself, as a do-it-yourself project?

Well, it is presented with typical Heathkit thoroughness, carefully packaged, complete literally to the last nut and bolt, and accompanied by the usual step by step assembly manual.

The evident intention is that the kits be capable of assembly on the kitchen table and, in fact, we did just that rather than work in the remoteness of the family workshop. Everything fitted together without the slightest hitch, without resource to anything as coarse as a drill or a file! Full marks on that score.

It took about 15 hours of actual work from unpacking the kit to switch-on and the first AM signal through the amplifier. This should be fairly typical for anyone working step by step through the manual but with the advantage of being able to recognise components at sight. Undoubtedly it could be done faster but, equally, it would be a slower process for anyone who had to rely entirely on the printed colour codes, etc.

What we did learn was the value of checking back at each phase of the construction, as suggested in the manual. Faced with a large number of wiring components, it is incredibly easy to make a mistake, even when you think you are being careful. Like mistaking a 1000-ohm resistor (brown-black-red) for a 200-ohm (red-black-brown).

It is essential, also, to work with a smallish, clean iron, under local lighting from a reading or bench lamp. Keep an old-fashioned reading glass by your hand and check the soldered joints as you complete a few at a time, for poor solder flow, excess solder, or whiskers. Care will pay off in the end result.

In our case, the tuner worked right from switch on, leaving only the final adjustments to put it in full working order. The manual contains two sets of alignment instructions: one for those who do not have access to instruments, one for those who do.

Because the tuner was rushed through in time for this issue, we did not have opportunity to observe it at length or to run full performance checks, but it certainly worked as expected. Equally, no stereo FM transmissions were available at the time of writing but the FM sound from TV Channel 4 Wollongong was clean and completely free from frame buzz or distortion. What's more, the AFC held it rock solid — all this without touching a single FM adjustment.

So there it is: a closer look at the technology, and a typical tuner for the new era in Australian broadcast listening

FM TUNERS & RECEIVERS IN BRITAIN

Writing in "Wireless World", Basil Lane observes that the choice of FM tuners and tuner / amplifiers in Britain is influenced quite heavily by price (or value for money) and by aesthetic appeal, rather than by the finer details of technology.

Technically, he says, most of the units can be broken down into similar block schematics, the main differences being in the component details. There is, however, an obvious trend towards greater use of integrated circuits, particularly in the IF stages, phase-lock decoders, ceramic filters, and FETs in the RF stage. Earlier enthusiasm for varactor diode tuning appears to have cooled. (Interestingly enough, the tuner featured here reflects all these trends).

However, there is plenty of scope beyond the basics for initiative, either for alternative approaches, or for facilities which are nice to have, provided the extra cost can be accepted. Here are a few specific examples:

TUNING METERS: Some designs feature two meters, a conventional "centre of channel" indicator and a signal strength meter which can be used to adjust and align aerial systems for maximum signal strength.

FERROGRAPH: Provides inter-station muting with the facility to vary threshold to suit individual requirements. Also, instead of a simple mono / stereo switch, a continuously variable separation control allows the user to choose an optimal setting when seeking to resolve a distant stereo program. The emphasis: DX.

CAMBRIDGE AUDIO: Tuner model T55 features MOS transistors in the RF and mixer stages and varactor diodes with a remote tuning facility; also remote signal strength indication and remote AFC switching. The emphasis: convenience.

SHERWOOD: Offers a digital display of the frequency to which the tuner is set. Also uses a 12-pole toroidal IF filter claimed to give extremely sharp rejection of unwanted frequencies. The emphasis: high technology.

TRIO: In one model, a "double switching stereo demodulator" which provides antiphase signals and the opportunity to cancel cross-talk, thereby improving stereo separation.

HARMON KARDON: One of the very few manufacturers to provide in-built Dolby-B for FM processing. This is in response to the action of some American FM stations using Dolby-B processing; the attitude of the BBC in England appears to be against the practice because it prejudices quality for the very large number of listeners who use conventional tuners in normal listening areas. (non-fringe)

Building our computer: three more sections

The description of our unique digital computer project continues here with construction details for the timing and run control board, the instruction decoder board and the accumulator board. The author also explains how to check the operation of these boards, in preparation for the addition of the remaining sections.

by JAMIESON ROWE

The timing and run control board is the uppermost of the EDUC-8 plug-in board stack, and is coded E8 / T. The circuitry on this board comprises the master clock oscillator, the run control logic, the timing pulse generator, and the major state generator. The logic diagram for these sections of the machine is shown in Fig 1.

The master clock oscillator uses a circuit which I have used in previous digital projects, and found to be stable and reliable. It is basically a relaxation oscillator using an RC integrator feedback circuit around a Schmitt trigger formed from half a 7413 device. A general purpose NPN silicon transistor (BC108, BC208, BC548, etc) is used as an emitter follower to reduce loading on the integrator. This makes it possible to generate stable frequencies as low as 0.1Hz using practical values of capacitance.

In this case the basic oscillator uses a 10k resistor and 220pF capacitor, giving a "fast" clock frequency of approximately 500kHz. To produce the "slow" clock frequency of 2Hz, the appropriate front panel switch connects a 47uF tantalum electrolytic capacitor in parallel with the 220pF. The connection to the switch and capacitor is made via contact pad 7 of the board edge connector, as shown.

The second half of the 7413 device is used as a buffer between the master clock oscillator and the run control logic. At the heart of this latter section is the run control flip-flop; this is a J-K element — half of a 7473 device —which controls the main gate admitting the clock pulses to the timing circuitry.

The clock input of the run control flip-flop is driven by the master clock pulses themselves, so that it operates the main gate synchronously. This ensures that the gate always opens and closes to pass complete clock pulses, and never fractional pulses. Opening and closing of the main gate is performed by the run control flip-flop in response to control signals applied to its J and K inputs by a second flip-flop, designated the "run flag".

The run flag flip-flop is a simple R-S type formed from two 7400 gate elements. It is initially preset to the state which produces a low logic level at the J input of the run control flip-flop, so that the main gate is closed. However a negative logic RUN COMMAND pulse fed to the run flag from the front panel circuit via edge connector pad 4 will cause the flag to switch to the set state, applying a logic high to the J input of the run control flip-flop. At the completion of the next master clock pulse the latter will therefore change state, opening the main gate to begin the machine running.

Before we go any further, let me digress briefly for a moment to introduce some abbreviations which I will be using frequently in the remainder of the present description, and those to follow. Without these abbreviations, the description would become both unwieldy and difficult to follow.

No doubt you will have noticed already that some logic signals we have encountered use the positive logic convention (high equals true), while others use the negative convention (low equals true). This occurs throughout the machine, the logic conventions for each signal having been chosen in order to simplify the logic and minimise the number of devices. In some cases the same signal is used in both positive and negative logic forms, for different purposes.

To simplify discussion from now on, a negative logic convention on the particular signal or signal version being referred to will be shown by means of the letter L in brackets. Lack of this symbol will therefore imply the positive logic convention. Hence RUN and RUN (L) would be the positive logic and negative logic versions of the same signal, respectively.

Other abbreviations which will be used are "FF" to stand for flip-flop, and "MCP" for master clock pulses. There will be others too, but these will be introduced as we go along. Note that negative logic signals are shown on the diagrams by a bar over the designation, and also by a "bubble" at logic element inputs and outputs. The diagrams also show the logical OR operation as a plus sign, whereas this will be spelled out in the text as the symbol is not available in our typesetting.

We should now be able to continue, in a slightly more elegant manner.

Halting of the machine is achieved by applying a negative pulse to the second input of the run flag FF, to change its state and apply a logic high to the K input of the run control FF so that it will close the main gate at the end of the current MCP.

Two different signals are used to reset the run flag FF for halting, the two being applied via a pair of 7400 gate elements connected to form a negative logic OR gate. One signal is a turn-on reset signal shown on the diagram as R(L), which will be discussed further shortly. The second signal is the normal "halt" signal (L), used to stop the machine running at the end of a deposit or examine cycle, or at the end of an execute cycle in response to a front panel control or a "HALT" instruction.

The halt (L) signal is produced by a 2-input gate, one input of which is fed by a positive logic pulse produced by the timing generator during the second half of T23, and accordingly shown as T23.5. The second input of the gate is fed from another gate which performs an OR between the DEP OR EXAM (L) signal from the flag on the front panel board, and the output of a further gate which ANDs the HLT COM signal from the front panel board with an EXECUTE signal produced by the major state generator.

This sounds more complicated than it really is, as the diagram shows. All it means is that during normal running, the run flag FF is turned off at time T23.5 if the machine is either performing a deposit or an examine, or if it is performing an execute cycle and the HLT COM signal is present.

Both the run control and run flag FFs are reset initially when power is applied to the machine, to prevent it from running until this is specifically commanded. This turn-on reset function is performed by the R(L) signal, generated by a simple circuit using a 7400 gate element whose two inputs are taken to earth via a parallel combination of a 100k resistor and a 47uF tantalum electrolytic capacitor.

When power is first applied, the capacitor is an effective short-circuit to ground applied at the gate inputs. This produces a logic high at the gate output, and hence the R(L) signal at the output of its following buffer inverter (½7420). However the capacitor soon charges through the gate input circuit, allowing the gate inputs to rise to the high level. The R(L) signal therefore disappears after it has served its purpose, and does not appear until the next time power is first applied after the machine has been off.

The purpose of the 100k resistor is to act as a bleed, so that the charge on the capacitor leaks away reasonably soon after the machine in turned off. At the same time, the RC time constant has been chosen so that the turn-on reset signal is not generated unless power to the machine has been interrupted for at least 2 or 3 seconds. This means that very short mains interruptions which would not upset operation, due to the reservoir action of the power supply electro, do not cause a reset to be generated.

As well as being used to reset the run flag and run control FFs upon turn-on, the R(L) signal is also used to perform the same function for the main timing counter and the other FFs in the timing and major state generator logic.

The main timing counter is a Fairchild 9316 4-bit synchronous binary counter, which receives master clock pulses directly from the main gate. A synchronous counter is necessary here, to ensure that all four counter outputs change state

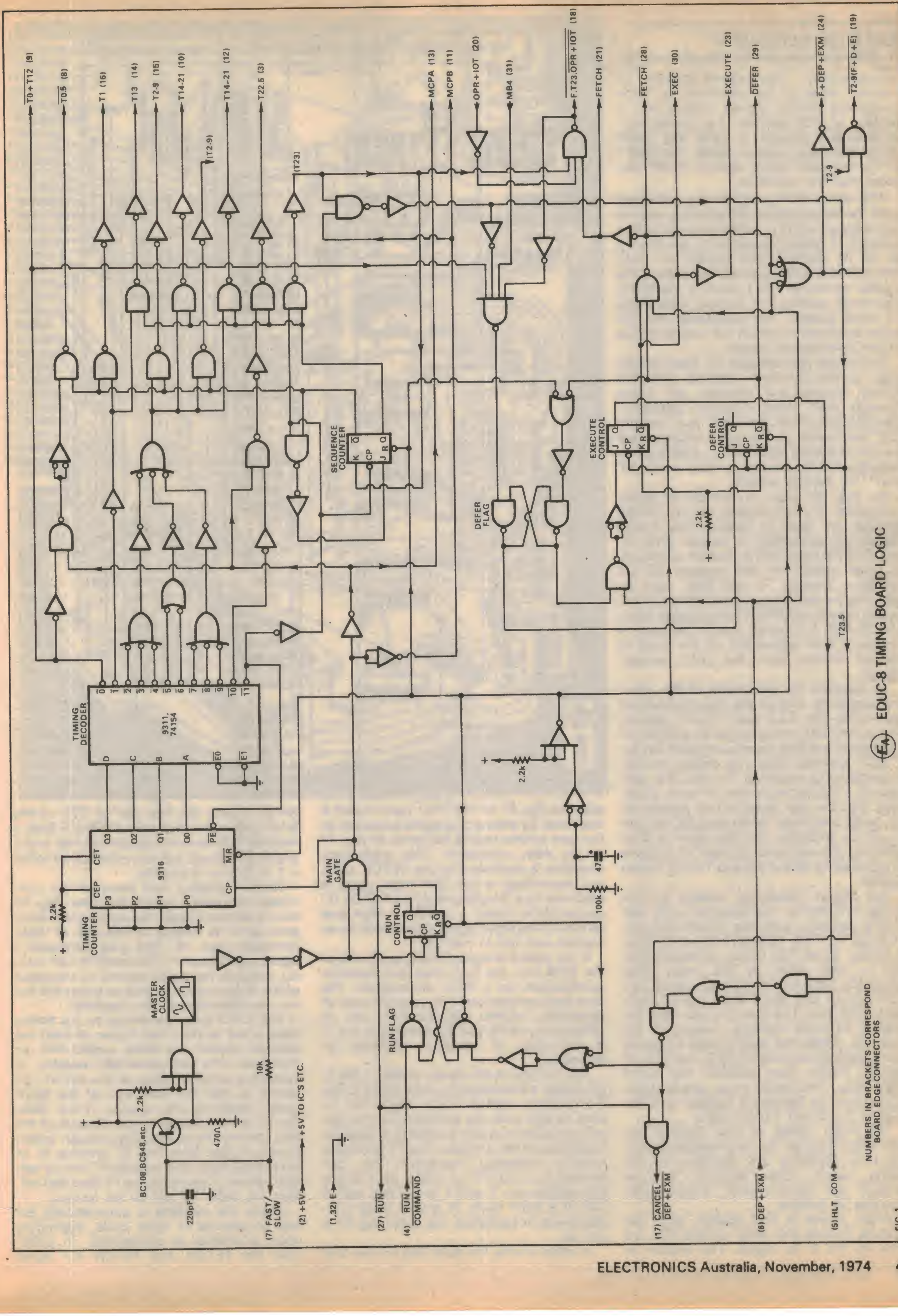


FIG. 1 EDUC-8 TIMING BOARD LOGIC

EDUC-8 computer

simultaneously. This allows groups of counter states to be combined to form continuous timing signals lasting for a number of MCP periods. If a normal non-synchronous counter is used, the small delays between outputs causes "notches" in the resultant timing signals, which can upset machine operation.

The actual timing signals are generated from the various states of the timing counter by means of a 9311/74154 decoder with a network of gates connected to the first 12 of its 16 outputs. The twelfth or 11(L) output of the decoder is also fed back to the parallel enable or PE(L) input of the 9316, effectively causing it to be reset after every 12 clock pulses. This establishes the 12-pulse sequence on which the various cycles of the machine are based.

The cycles are actually 24 clock pulses long, so that for each machine cycle the timing counter and decoder run twice through their basic 12-pulse sequence. Identification of the "first half" and "second half" sequences of the cycles is performed by the sequence counter FF, whose clock pulse input is fed with an inverted version of the 11(L) decoder output.

As may be seen, a number of gates connected to the outputs of the timing decoder are used to produce raw timing signals corresponding to various time intervals in the basic timing counter sequence. In most cases the two outputs of the sequence counter FF are then used to separate the raw timing signals into the final timing signals required. The exception is the TO-OR-T12 (L) signal, which because it occurs in both sequences of the cycle is derived directly from the O(L) decoder output.

To illustrate the generation of the other timing signals, look at the logic involved in generating the T2-9 and T14-21 signals. These are both used for serial shifting of instruction and data words, and both last for 8 MCP periods which by design occupy corresponding positions in the first and second 12-pulse sequences of each cycle. Note that the raw signal is first derived by the gates connected to the decoder outputs 2 — 9 (L), inclusive, and this signal is then gated by the sequence counter FF outputs to produce the final T2-9 and T14-21 timing signals.

The signals generated directly by the timing circuitry for use throughout the rest of the machine comprise T0-OR-T12 (L), T0.5 (L), T1, T13, T2-9, T14-21, and T22.5. A further signal T23 is also generated, but this is used solely by the major state generator. Note that there are actually two T2-9 signals and two T14-21 signals, with duplicated logic. This is a carryover from the original 32-word memory version of the machine, where the second sets of gating were required to produce T5-9 and T17-21 signals. Rather than redesign the board completely, the gates have simply been swung over to operate in tandem with the original T-2-9 and T14-21 logic.

The major states of the machine are defined by the logic circuitry associated with the two remaining J-K flip-flops on the timing board, those labelled "execute control" and "defer control". This circuitry operates as follows.

When power is first applied, both the execute control and defer control FFs are reset by the R (L) signal. The deposit or

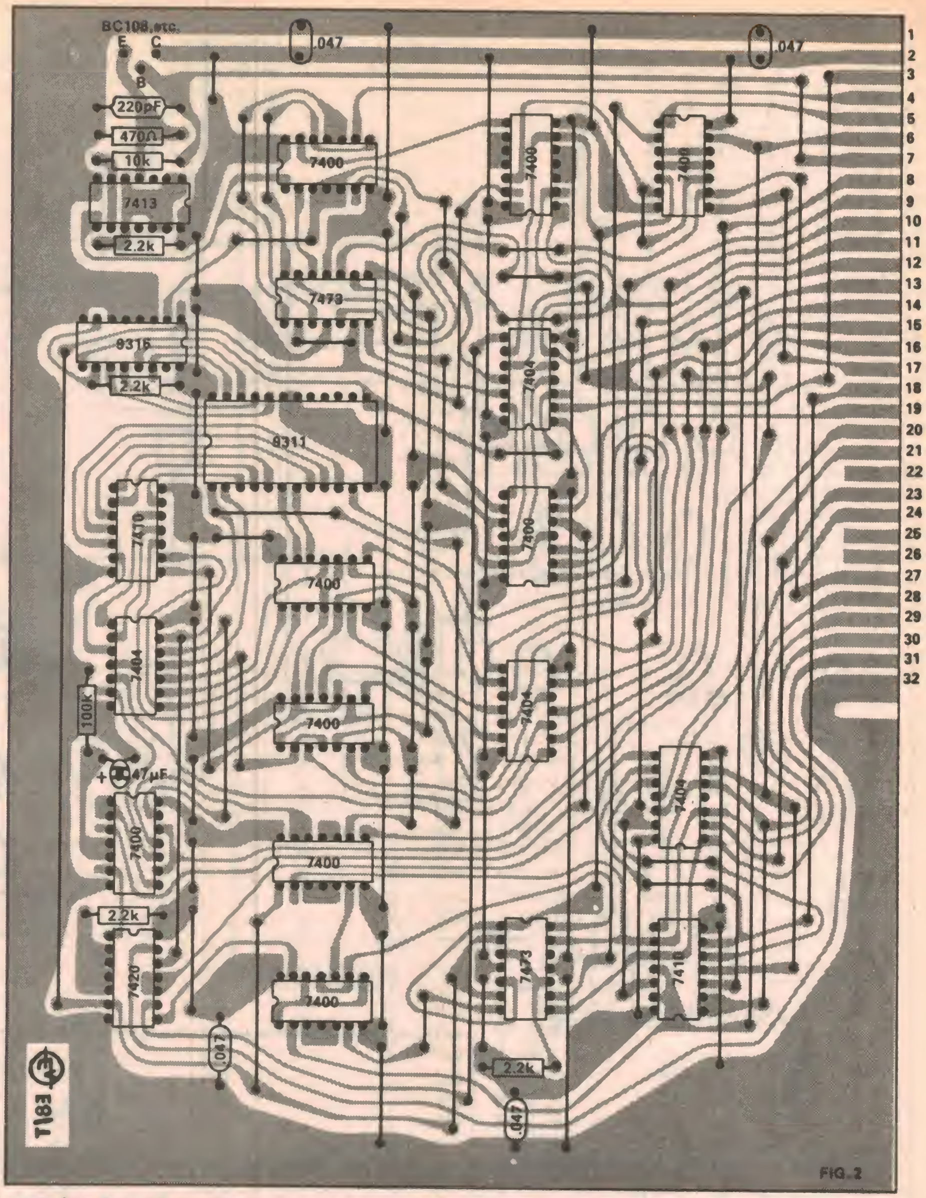


FIG. 2

examine flag FF on the front panel board is also reset, by means of a signal produced by the gate whose output connects to pad 17 of the edge connector. This preliminary condition is equivalent to the FETCH state, and accordingly a low level logic signal is produced by a 3-input gate at the FETCH (L) output of the circuit — pad 28. A high level version of the same signal is produced by an inverter and fed to pad 21.

If the machine is set running by means of the RUN key, the first cycle will therefore automatically be a fetch, as required. The next cycle entered depends upon the type of instruction fetched and decoded, and on whether or not bit 4 of the instruction is a 1, in the case of memory reference instructions.

The decision is effectively made by the 4-input gate whose output is connected to the R-S flip-flop marked "defer flag". The inputs to this gate are arranged so that the only situation in which it delivers a negative logic pulse to set the defer flag FF is when a memory reference instruction has ben fetched (i.e., not IOT or OPR), bit 4 of the MB register is a 1, and it is the first half of T23 of a fetch cycle. If any of these conditions are not satisfied, the defer flag FF is not set.

In other words, the defer flag FF can only be set during the first half of T23 of the fetch cycle, and then only if there is both a memory reference instruction fetched. and it is also an indirect address instruction having a 1 in the bit 4 position.

Note in passing that some of the conditions necessary before the defer flag FF can be set are actually tested by the 3-input gate with its output connected to edge connector pad 18. This gate produces a signal designated F.T23.not(OPR OR IOT) (L), which is fed via an inverter to one input of the 4-input gate as well as being fed out for use elsewhere in the machine.

The T23.5 pulse generated by the timing logic is fed to the clock inputs of both the execute control and defer control FFs, so that both FFs are potentially capable of switching to the set state at the end of T23 (which is also the very end of the fetch cycle). However the outputs of the defer flag FF are connected to the J inputs of the two control FFs so that only one can in fact be set. If the defer flag FF remains in its initial reset state, the execute FF will be set; alternatively if the defer flag FF has been set, then the defer FF will be set instead.

Hence the machine is automatically led into an execute or defer cycle, depending upon whichever is appropriate. In either case the FETCH and FETCH (L) signal

outputs are reversed in polarity, to signify that the fetch cycle has ended, and either the EXEC and EXEC (L) outputs are taken high and low respectively, to indicate an execute cycle, or the DEFER (L) output is taken low to indicate a defer cycle.

If the execute control FF is set, the machine enters an execute cycle and performs the instruction concerned. Then at the end of the cycle, the T23.5 timing pulse will reset the execute control FF so that the machine will return to a new fetch cycle.

On the other hand if the defer control FF is set, the machine enters a defer cycle and reads out of the memory the actual address of the instruction operand. At the start of the cycle the defer flag FF is also reset, as the DEFER (L) signal is fed back to the gate and inverter connected to its reset input. As a result, when the end of the defer cycle is reached, the T23.5 timing pulse not only causes the defer control FF to be reset, but also sets the execute control FF. Hence the machine ends the defer cycle and correctly enters an execute cycle.

If the machine is set running normally by means of the RUN key, it therefore continues to run through alternate fetch and execute cycles, with defer cycles automatically interposed between fetch and execute wherever necessary for indirect memory reference instructions. This operation only stops if a halt command is encountered, as a result of the operator pressing the HALT key, or by execution of a halt instruction.

The machine also starts running if either the deposit or examine keys are pressed, as explained earlier. However in this case the deposit or examine flag FF on the front panel will be set, so that the DEP OR EXM (L) signal will be fed to the timing and control board via edge connector pad 6.

This signal has a number of effects. One is that it ensures that the run flag FF is reset by the first T23.5 timing pulse generated, so that the machine automatically halts after a single cycle. At the same time, the 3-input gate which produces the FETCH (L) signal is blocked, so that the machine does not confuse a deposit or examine cycle with fetch. This also has the effect of preventing the defer flag FF from being set during the first half of T23, by blocking the 4-input gate (via the F.T23.not(OPR or IOT) (L) 3-input gate).

In addition, the DEP OR EXM (L) signal also prevents the execute control FF from setting at the end of the cycle, by holding down one input of the 2-input gate attached to the latter's J input.

These actions all ensure that for deposit or examine, the machine runs only for a single 24-pulse cycle and then stops without upsetting the major state circuitry. Note that at the end of the cycle, the deposit or examine flag FF on the front panel is automatically reset by means of the CANCEL DEP OR EXM (L) signal produced by the gate attached to edge connector pad 17.

Two further logic and timing signals are derived on this board. One is (F OR DEP OR EXM) (L), fed to pad 24. The other is a version of the same thing gated by T2-9, and fed to pad 19.

Hopefully the foregoing description will have given you a reasonably good idea of the operation of the run control, timing and major state generator logic. It has not been possible to describe the exact function of every gate and inverter, but if this were attempted it would take far more space than is available — and probably be rather confusing.

The wiring of this board should be fairly self-evident from the diagram of Fig. 2. There are 21 ICs, a few small components and a number of wire links. The main things to watch are the position and orientation of the ICs, and that the links are fitted correctly. It is a good idea to use insulated wire for the links, to prevent accidental shorts. I used single-conductor PVC covered hookup wire.

Don't forget to cut the slot next to pad 32 of the edge connector strip, so that the board can be plugged into the top socket. It may be necessary to file the side of the slot nearest pad 32, and also perhaps the end of the board next to pad 1, to ensure that the board will fit into the socket with all of the pads mating correctly with the socket clips.

The same sort of preparation will probably be necessary with the other plug-in boards, as there will inevitably be small errors in the boards as they come from the manufacturer.

Decoder board

We can now turn our attention to the second plug-in board, which is that for the instruction register and decoder, with the code E8 / D. The logic for this "decoder board" is shown in Fig. 3.

As you can see, the heart of this board is a Fairchild 9334 IC, which actually functions as both the instruction register (IR) and the instruction decoder. This is because the 9334 is what the maker describes as an 8-bit addressable latch. In effect it comprises a 3-bit binary decoder with inputs A0, A1 and A2, whose eight outputs are coupled internally to eight R-S latch flip-flops.

When a low logic level is applied to the C input, all of the internal FFs are reset. Then if a low logic level is applied to the E input, whatever logic level is present at the D input will be stored in whichever of the eight FFs corresponds to the decoded 3-bit number applied at the A0, A1 and A2 inputs. In effect, it is an eight-bit memory, where D is the data input, E the write enable input and the three A connections the address inputs.

In this application we clear all the internal FFs of the device at time T0.5 of the fetch cycle, by means of the simple gating shown connected to the C input. Then, at time T22.5 in the fetch cycle, after the instruction has been fetched from the memory and has settled in the MB register, a low logic pulse is applied to the E input. As the D input of the device is connected to logic high, and the three A inputs are connected to bits 7, 6 and 5 of the MB register via edge connector pads R, Q and P, this has the effect that the operation code of the instruction is decoded, and the corresponding 9334 output FF set.

Hence if the operation code is 010 (octal 2), output Q2 would be set. Or if it is 110 (octal 6), output Q6 would be set. Whatever the operation code, one and only one of the outputs will go high, and will remain high until T0.5 of the next fetch cycle.

Although the 9334 output concerned thus provides the decoded form of the instruction operation code from T22.5 of its own fetch cycle until T0.5 of the following fetch, this signal is in most cases only used during the execute cycle. Hence the 9334 outputs are not used directly, but are gated by the EXEC signal from the major state generator. This produces the eight primary instruction outputs, all of which are fed to edge connector pads A—H inclusive, in negative logic form: AND (L), TAD (L), ISZ (L), DCA (L), JMS (L), JMP (L), IOT (L) and OPR (L).

An (OPR OR IOT) signal ungated by the EXEC signal is also produced, and fed to connector pad 16. The reason why the signal is not gated by the EXEC signal is that it is used primarily on the timing and control board (pad 20), to prevent the defer flag FF being set for IOT or OPR instructions. To be effective, it must therefore be present during T23 of the fetch cycle.

The additional gating attached to the Q6 and Q7 outputs of the 9334 is involved in decoding the augmented operation code of the IOT and OPR instruction formats. Thus the IOT signal is further gated by the signals from MB register bits 0,1 and 2 to produce the CLEAR IOT FLAG (L), IOT SHIFT (L) and SKP ON IOT FLAG signals respectively, fed to connector pads 6, 11 and 7.

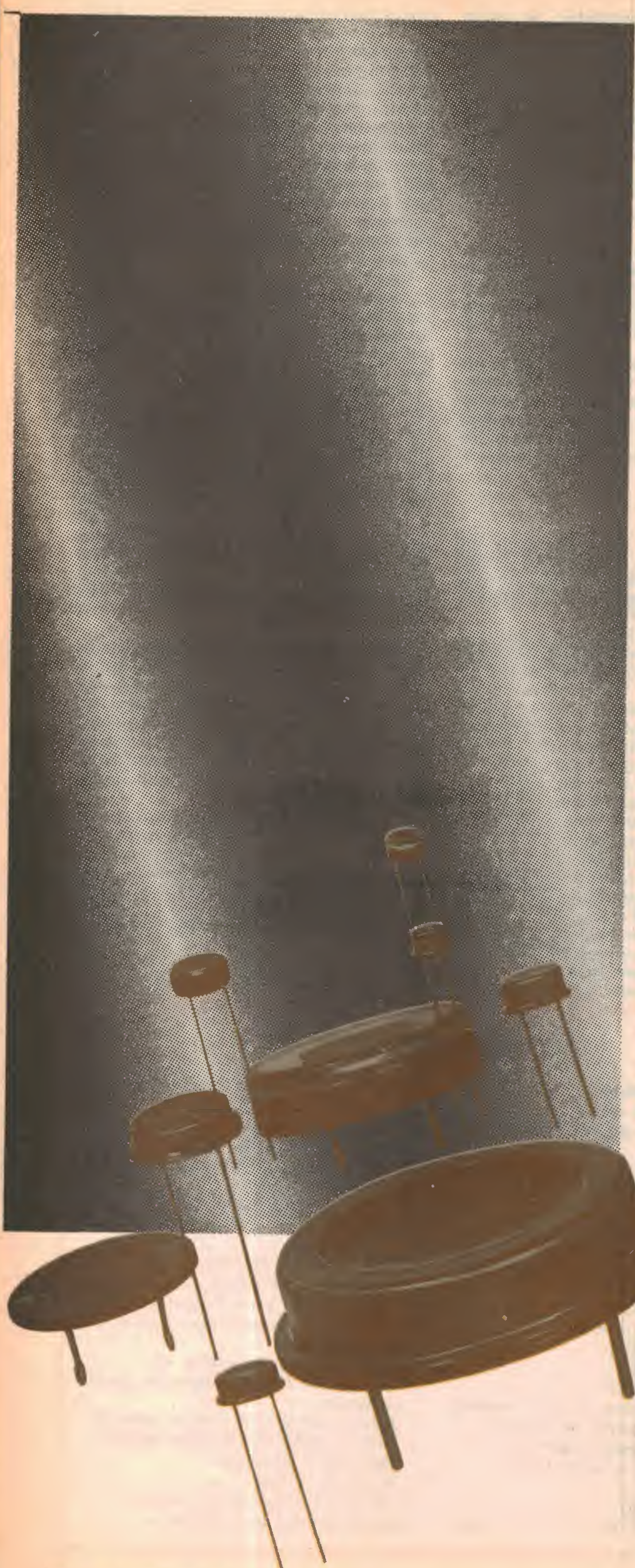
Similarly the OPR signal is gated by both

EDUC-8 PARTS LIST — 2

TIMING AND CONTROL BOARD
1 PC board, code E8/T, 21.5 x 16cm
1 BC108, BC208, BC548 or similar NPN transistor
9 7400 or 9002 quad 2-input gate IC
4 7404 or 9016 hex inverter IC
2 7410 or 9003 triple 3-input gate IC
1 7413 or 9N13 dual Schmitt IC
1 7420 or 9004 dual 4-input gate IC
2 7473 or 9N73 dual J-K flipflop IC
1 9311 or 74154 16-way decoder IC
1 9316 synchronous 4-bit counter IC
1 470 ohm ¼W resistor
2 2.2k ¼W resistors
1 10k ¼W resistor
1 100k ¼W resistor
1 220pF polystyrene or NPO ceramic
4 .047uF LV polyester or ceramic
1 47uF 6VW tantalum electrolytic
Insulated hookup wire for links

DECODER BOARD
1 PC board, code E8/D, 21.5 x 16cm
8 7400 or 9002 quad 2-input gate IC
2 7404 or 9016 hex inverter IC
2 7410 or 9003 triple 3-input gate IC
1 7420 or 9004 dual 4-input gate IC
1 9334 eight bit addressable latch IC
2 2.2k ¼W resistors
3 .047uF LV polyester or ceramic
Insulated hookup wire for links

ACCUMULATOR BOARD
1 PC board, code E8/A, 21.5 x 16cm
2 7400 or 9002 quad 2-input gate IC
2 7401 or 9012 quad 2-input gate with open collectors
1 7404 or 9016 hex inverter IC
2 7405 or 9017 hex inverter with open collectors
1 7410 or 9003 triple 3-input gate IC
2 7495 or 9395 four-bit shift register
1 820 ohm ¼W resistor
3 2.2k ¼W resistors
4 .047uF LV polyester or ceramic
Insulated hookup wire for links



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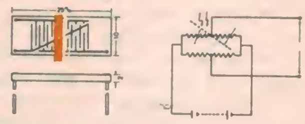
Photentiomatic

Photobridge



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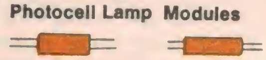

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AC93/R2

the MB bit 4 and its complement, and in each case then further gated by MB bits 0,1,2 and 3 to produce the eight OPR microinstruction signals CLA (L), CMA (L), RAL (L), IAC (L), SZA (L), SMA (L), RAR (L), and HLT (L). These are fed to connector pads 31 — 24 inclusive, as shown.

The remaining logic circuitry on the instruction decoder board is involved in producing secondary gating and timing signals, by combining the foregoing primary instruction and microinstruction gating signals with timing signals. Thus a T14-21. (JMS OR JMP) (L) signal is produced by combining the JMS (L) and JMP (L) signals in a gate performing the OR function, and then gating this with the T14-21 timing signal. The resultant is fed to connector pad 17, as shown.

Similarly a T2-9. (TAD OR IAC OR CMA) (L) signal is produced and fed to pad 13, and a T2-9 ISZ(L) signal produced and fed to pad 14. A (JMS OR DCA) signal is also produced and fed to pad 15.

Signals corresponding to those instructions and microinstructions which involve PC register incrementing or "skipping" — ISZ (L), SZA (L), SMA (L) and SKP ON IOT FLAG (L) — are also combined by a 4-input gate performing the OR function, and gated with the T14-21 signal to produce a signal designated T14-21.SKP (L), which is fed to pad 18.

And finally, signals corresponding to both the major states and instructions which involve the memory are assembled by a 4-input gate and a 3-input gate, both performing the OR function, and gated with the appropriate T2-9 and T14-21 timing signals. The outputs of the two gates are then combined by a further gate performing the OR function, to produce a signal designated MEMORY ENABLE. This is fed to pad 23.

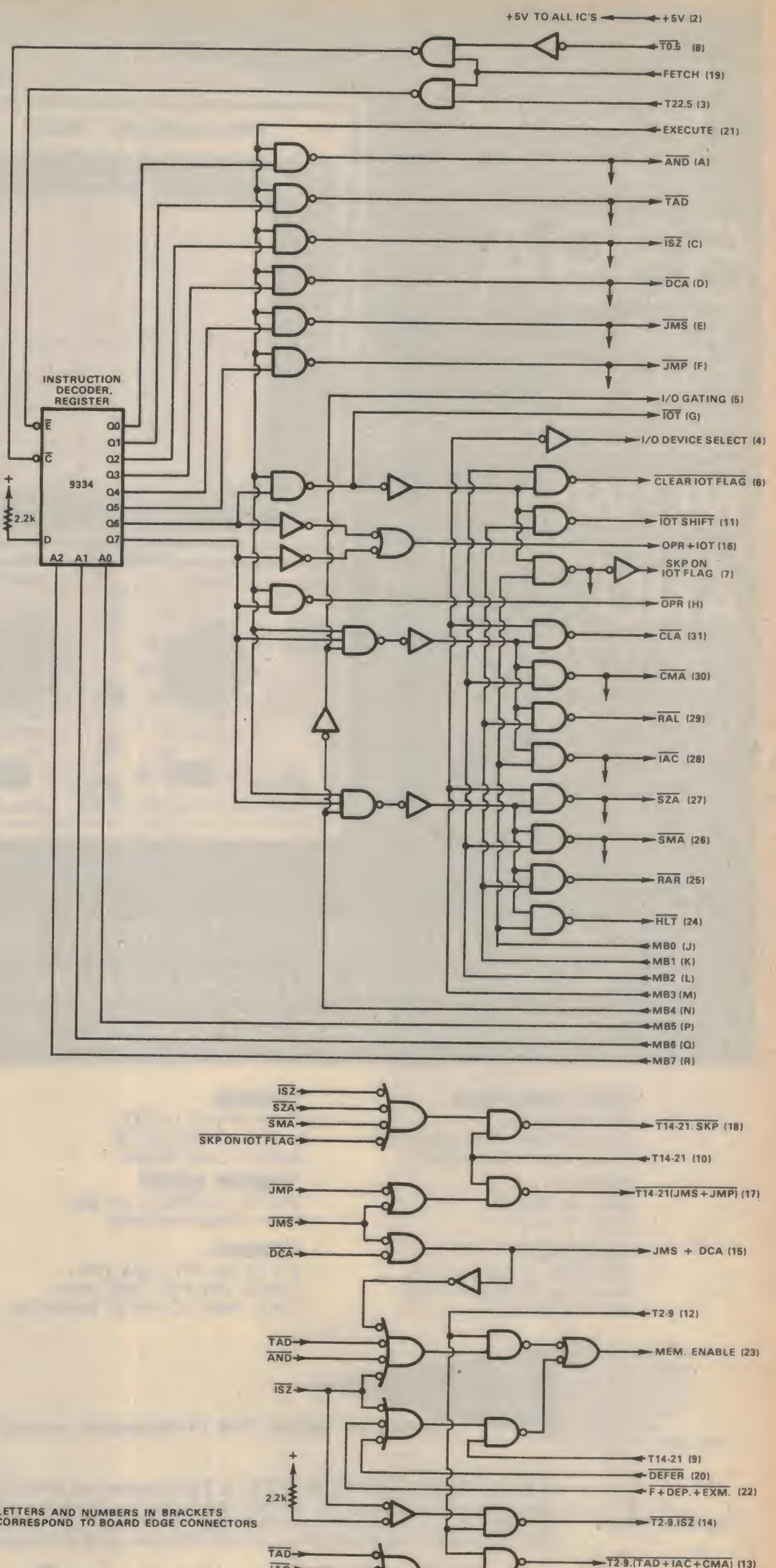
Wiring of the decoder board should be fairly self-evident from the diagram shown in Fig. 4. There are only 14 ICs, five minor parts and again a number of wire links. As before the main things to watch are that the ICs are correctly orientated, in their correct positions, and that the wire links are in their correct positions.

The decoder board plugs into the mother board position second from the top, immediately below the timing and control board.

Accumulator board

The third section of EDUC-8 to be described at this stage is that comprising the accumulator (AC) register and its associated logic. This section is on the plug-in board coded E8 / A, and for convenience described as the accumulator board. The logic diagram is shown in Fig. 5.

As may be seen, the heart of this section is the AC register itself, which is simply formed by two 7495 four-bit shift register ICs connected together to form an 8-bit register. The 7495 devices are internally connected for right shifting, which is of course used for shifting data into and out of the register, and also for the RAR microinstruction. To achieve the left shifting required for the RAL microinstruction, the parallel inputs PA—PD of both devices are connected to the outputs of the "next right" positions. The PD input of the right 7495 is connected to the A output of the left, to



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EDUC-8 DECODER BOARD LOGIC

FIG. 3

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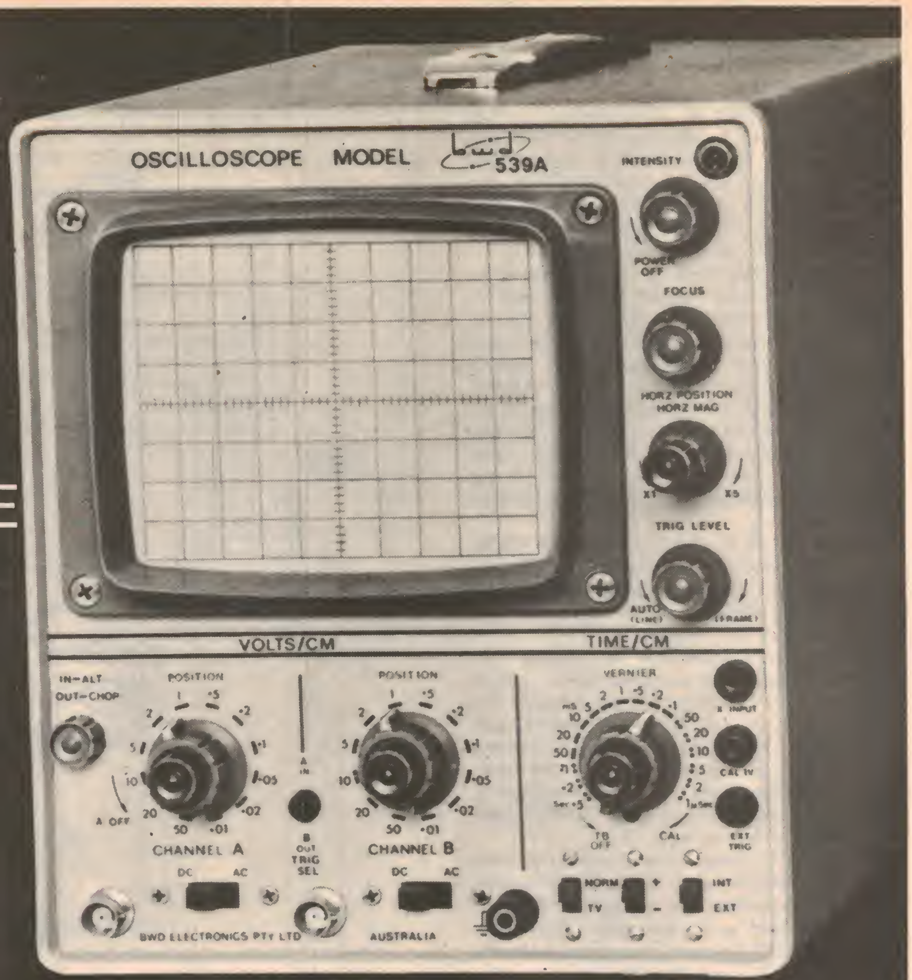

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complete the loop so that all 8 bits are retained.

The RAL (L) signal input at pad F is taken to the "mode" (M) inputs of the two 7495s, via an inverter to give the correct logic polarity. Thus when the RAL microinstruction occurs, the devices are switched to the parallel loading mode. As the parallel load clock inputs (CP2) are connected to the T1 timing signal input on pad 13, a left shift of one bit thus occurs at time T1 of an RAL execute cycle.

The outputs of all eight AC bits are taken to connector pads J—R inclusive, for connection to the LED indicator drivers on the front panel board. AC bit 0 is also connection to pad 11, for shifting of data to the IOT interface board. Eight open-circuit collector inverters with their inputs connected to AC bits 0-7 and their outputs commoned and taken to the positive rail via an 820 ohm resistor are used to perform the NOR function, so that their output at pad 15 is at logic high level only when all eight AC bits are zero. This signal is used when executing the SZA microinstruction.

The shift right clock pulse inputs CP1 of the two 7495 ICs are commoned and fed via an inverter from a gate which ANDs master clock pulses arriving at pad 9 with one of a number of signals fed to it via the associated gates. Thus a single clock pulse is fed to the AC at T13 of an RAR microinstruction execute cycle, due to the T13.RAR (L) signal from pad 8. Similarly eight pulses are applied during T2-9 of the execute cycle of a TAD instruction or an IAC or CMA microinstruction, due to the T2-9.(TAD OR IAC OR CMA) (L) signal from pad 14, and so on.

The bit 0 output of the AC is applied to one input of the gate marked AND, the other input of which connects to the D-bus input on pad 7. After passing through an inverter to restore the logic polarity the output of the AND gate is then gated by an inverted version of the AND (L) signal from pad A. Thus during the execute cycle of an AND instruction, a path is provided for serial ANDing of the number in the AC with the number read from the memory via the D-bus. The resultant is fed to the A-bus, pad 4, and then back to the input of the AC via an inverter.

The remaining logic of this section is involved with connection of the AC bit 0 output to either the B-bus or C-bus (pads 5 and 6), as required, for various instructions and microinstructions. I will not trace through this in detail, to conserve space. However it may be worth noting that the effect of the CLA (L) signal from pad H is to block two of the paths between AC0 and the B-bus, whereas the effect of the other inputs is to enable a path between AC0 and either the B-bus or C-bus.

The logic has also been arranged so that the CLA microinstruction can be combined with either the IAC or CMA microinstructions, and IAC also combined with CMA.

As before the wiring of the accumulator board should be straightforward, using the diagram of Fig. 6 as a guide. There are 10 ICs, some nine minor parts and a number of wire links, and here again the IC orientation and position should be watched carefully to avoid errors. This board plugs into the second bottom position on the mother board, which is the uppermost of the two positions having two 16-way edge connectors.

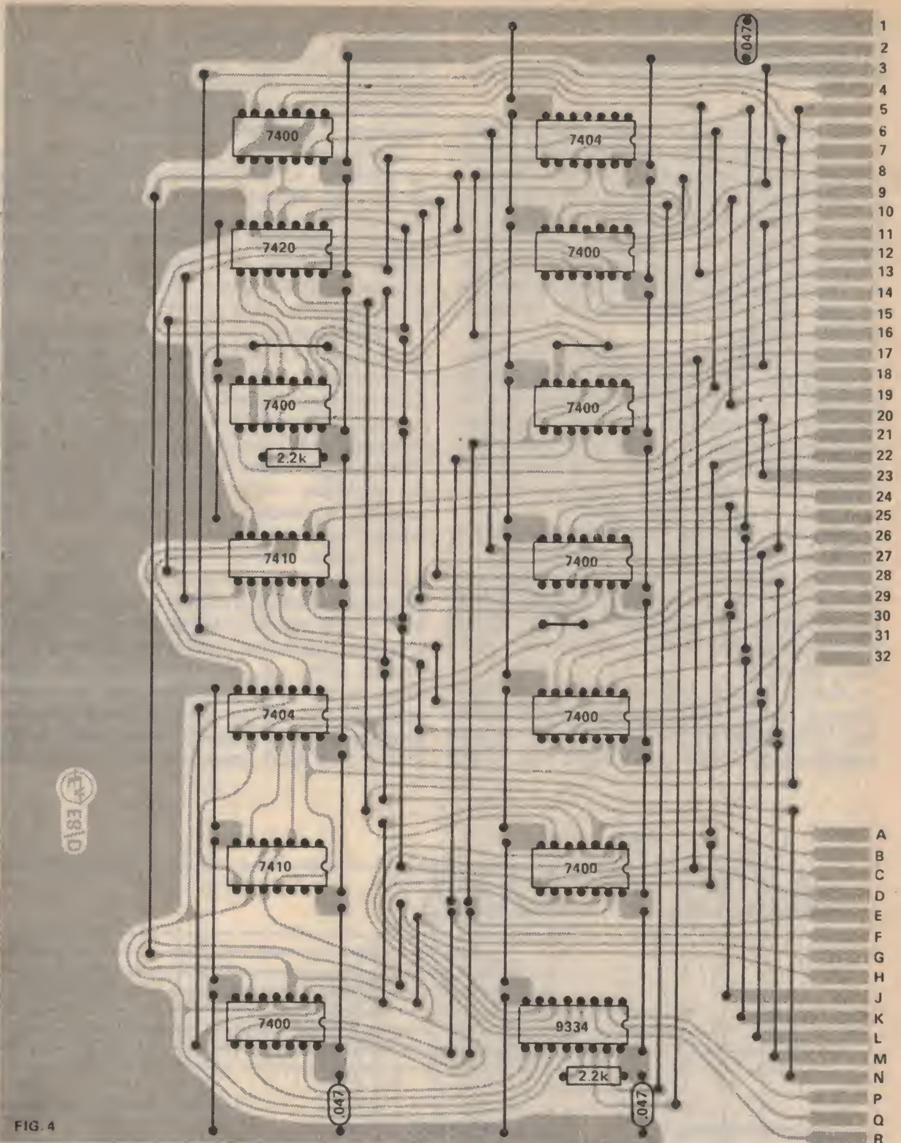


FIG. 4

When the three boards described in this section have been wired up and checked against the diagrams for errors, they may be plugged into their respective sockets — assuming that all seems well. It will now be possible to test many of the basic functions performed by these sections of the machine, and this is a good idea before you proceed to build up the remaining sections.

Testing progress

In order to perform the tests it is necessary to make temporary connections between the switch register pads SR0-7 on the front panel board (also available on the 16-way input device connector), and the MB0-7 connector pads on the left-hand end of the mother board. SR0 should be connected to MB0, SR1 to MB1, and so on, down to SR7 and MB7. This is to allow the switch register to be used to "dummy" or substitute for the MB register, as yet unwired.

With these temporary connections made, apply the power. If all is well, the only LED which will light on the right-hand side of the front panel will be that for FETCH, which is normally lit when the machine is not running. On the left-hand side of the front panel, the LEDs for the PC and MA registers should all be glowing, while those for the MB register should correspond to the positions of the SR switches — up switches producing a glowing LED, and down switches producing a dark LED. The LEDs for the AC register will light in a random pattern at this stage, and have no particular significance apart from reflecting the turn-on bias of the FFs in the AC devices.

For a first test, make sure that you can set the MB register LEDs to any desired binary number by setting it up on the SR switches. This ensures that you have the temporary connections right, so that the SR can indeed be used as a substitute MB register to feed in instructions.

Now set the FAST/SLOW switch to the upper or slow position, and the SINGLE/CONT switch to the upper or single step position. The machine will now be set for slow running, and single stepping. Then set all eight of the SR switches to the down or 0 position, in effect giving the machine an AND instruction directly addressing memory location 0000 (which at this stage does not exist, of course — nor does any other location).

EDUC-8 computer

You are now ready for the first big test. Watching the LEDs on the right-hand end of the front panel, press the RUN key. The run LED should light, showing that the machine has started running, while the fetch LED should remain lit — showing that it is valiantly trying to perform the fetch cycle, slightly handicapped at this stage by the lack of both the PC register and the complete memory system!

The fetch LED should remain lit for about 12 seconds, then it should go dark and the execute LED should glow, showing that the machine has correctly entered an execute cycle. At the same time the AND instruction LED should light, showing that the correct "instruction" has been decoded and its execution is being attempted.

Both the execute and AND instruction LEDs should remain lit for another 12 seconds or so, whereupon both they and the run LED should go dark, indicating that the machine has stopped running. When this happens the fetch LED should come back on again.

During the execute cycle you may have noticed that if there was a number other than 00000000 in the AC register, it was apparently shifted around eight bits to the right, to end up where it began. This is normal, as the machine performs the AND operation between the number in the AC and a logic "1" effectively present on the D-bus when the memory board is absent. The resultant is returned to the AC.

If all is well so far, set SR switch 4 to the up position, to simulate the MB4 bit being set to 1 for indirect addressing. Then press the RUN key again. The previous chain of events should now be repeated, except that before entering the execute cycle the machine should spend about 12 seconds with the defer LED glowing.

If this checks out also, set switch SR4 down again and set SR5 to the up position, to simulate a TAD instruction. Pressing the RUN key should produce a repeat of the first sequence, except that this time the TAD instruction LED should glow during execute. The number in the AC will also be lost, as the machine will shift it out to attempt passing it through the serial adder (at present non-existent).

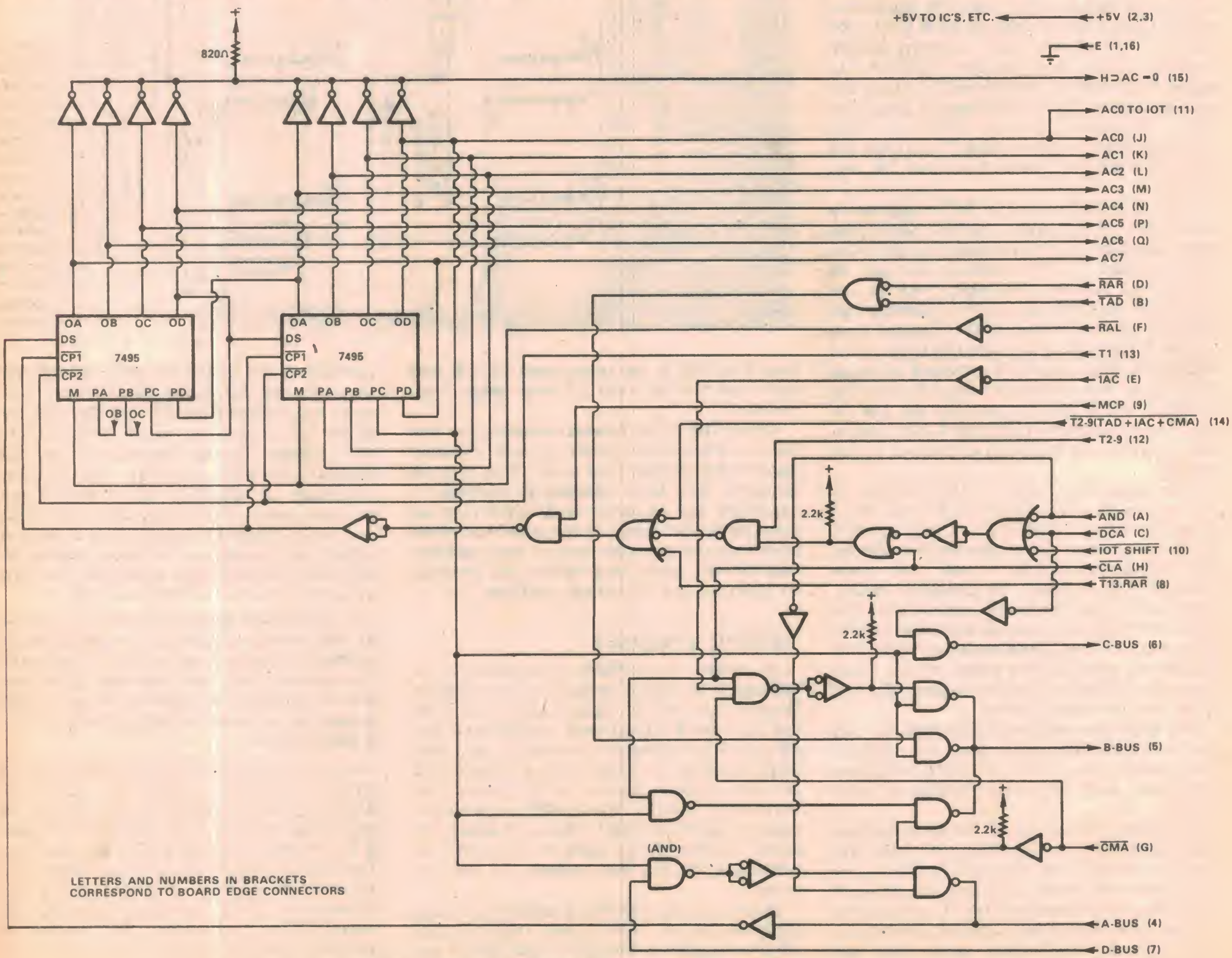
In similar fashion you can check the decoding of the remaining primary instructions, simply by setting SR5, SR6 and SR7 to the appropriate operation code. And you can check that with bit 4 set to a 1 by having SR4 up, the machine will pass through the defer state between fetch and execute, for the six memory reference instructions. You should conversely check that it does NOT enter a defer cycle for the IOT and OPR instructions, despite SR4 being up!

Finally, you can test those of the OPR microinstructions which change the content of the AC, without requiring the adder. These are CLA, CMA and RAL. The other two content-changing microinstructions (IAC and RAR) can also be partially checked, but at this stage will not work properly because of the absence of the adder.

To perform these checks, first set the SLOW/FAST switch to the down, or fast position. Then set switches SR7, SR6 and SR5 to the up position, to simulate the OPR operation code (octal 7). Leave the SINGLE/CONT switch in the up position, for single step operation.

As the AC register content is probably zero by this stage, the best microinstruction to try first is probably CMA. So set switch SR2 to the up position and switches SR4, SR3, SR1 and SR0 to the down position, to set up the full CMA coding (octal 704). Then press the RUN key, whereupon the AC should be set to 11111111 (equivalent to minus 1 in two's complement binary arithmetic).

Pressing the RUN key again should restore the AC content to all zeroes again, and further presses should simply cause the two AC content situations to alternate back and forth. Make sure that you end the test with the AC content at minus 1, though, so



EDUC-8 ACCUMULATOR BOARD LOGIC

FIG. 5

that you are ready to perform the next test.

This time set switch SR2 down, and SR3 up instead. This produces octal code 710, or that for CLA. Pressing the RUN key should now simply wipe out the AC content, leaving it zero. Continued pressing should have no effect.

To test the RAL instruction, it will be necessary to have an AC content other than zero or minus 1, because these both look the same no matter how many times they are shifted left! The easiest way to give the AC a suitable content is probably to turn the power off for about 10 seconds, then turn it back on. The AC content should then come up with a random value, hopefully neither zero nor minus 1.

If you are unlucky, and the AC does come up with zero or minus 1 consistently, there is still a way to produce a suitable AC content. This is by using the RAR microinstruction, which as yet will function only partially but sufficient for our purpose.

First set the SR switches back for CMA (octal 704), and press the RUN key to give the AC a content of minus 1. Then set the SR switches to octal 722, representing RAR (SR7, 6, 5, 4 and 1 up, SR3,2 and 0 down). Pressing the RUN key a few times should then move zeroes into the AC from the left hand end. Do this until you have about 3 or 4 bits left in the AC set to 1.

Having produced a suitable content in the AC by one or other of these methods, now set the SR switches for the RAL microinstruction (octal 702). Pressing the run key should cause the number in the AC to be shifted one bit position to the left, with the value of AC bit 7 being transferred around into bit 0. Further shifting should be produced by continued pressing of the RUN key.

At this stage you will have tested all of the microinstructions capable of being performed properly by the machine in its incomplete form. You can if you wish test the RAR microinstruction partly, along the lines just described for setting up the AC for the RAL test. You can also try the IAC microinstruction (octal code 701), although at this stage it will simply act in the same way as CLA or DCA — simply clearing the AC of any content and leaving zero.

Hopefully, your machine will have passed all these tests, and you will be ready to work on the program counter and adder board, and the memory board. These will be described next, so that before long you will be able to get the machine actually running in its basic form.

Troubleshooting

If you have struck trouble, in that your machine doesn't perform as it should, there are probably three likely causes. One is that you may have made a wiring error, such as an IC in the wrong position or around the wrong way, or a wire link in the wrong position. The second possibility is that you have a faulty connection in one of the PC edge connectors — in which case cleaning the board connector pads with a cloth soaked in methylated spirit may help, or failing this judicious bending of a guilty socket clip may be required.

The third possibility is a faulty IC, which does occasionally occur. Here the trick is to find the guilty device, of course, after which the remedy is obvious.

I myself have encountered only two faulty ICs, both of which were 7400 quad 2-input gate devices. In both cases only one of the four gates was faulty, but the symptoms were identical: the gate operated purely as an inverter from one input, completely ignoring the other input. This suggests a broken bonding wire from the package pin to the chip, and it was perhaps significant that both devices were of the moulded plastic variety.

In both cases the effect of the fault in terms of machine operation was to cause the machine to perform an operation not only when it should, but at other times as well. In one case it skipped on the SMA microinstruction regardless of whether the AC was actually negative or not, for example.

In a nutshell, the approach to use when troubleshooting is to first study carefully the symptoms, noting exactly what is going wrong, and when (use the slow running mode to help spot timing). Then look carefully at the logic diagram, and you will often be able to narrow down the fault area quite closely. Finally, test out your theory about where the fault may lie, using a logic probe or a scope to analyse what is going on.

It takes a while to get the hang of this, but you'll find it will probably come to you faster than you may anticipate. At first, the logic circuits may seem bewilderingly complex, but in reality only a small part of the total circuit is generally involved at any one time.

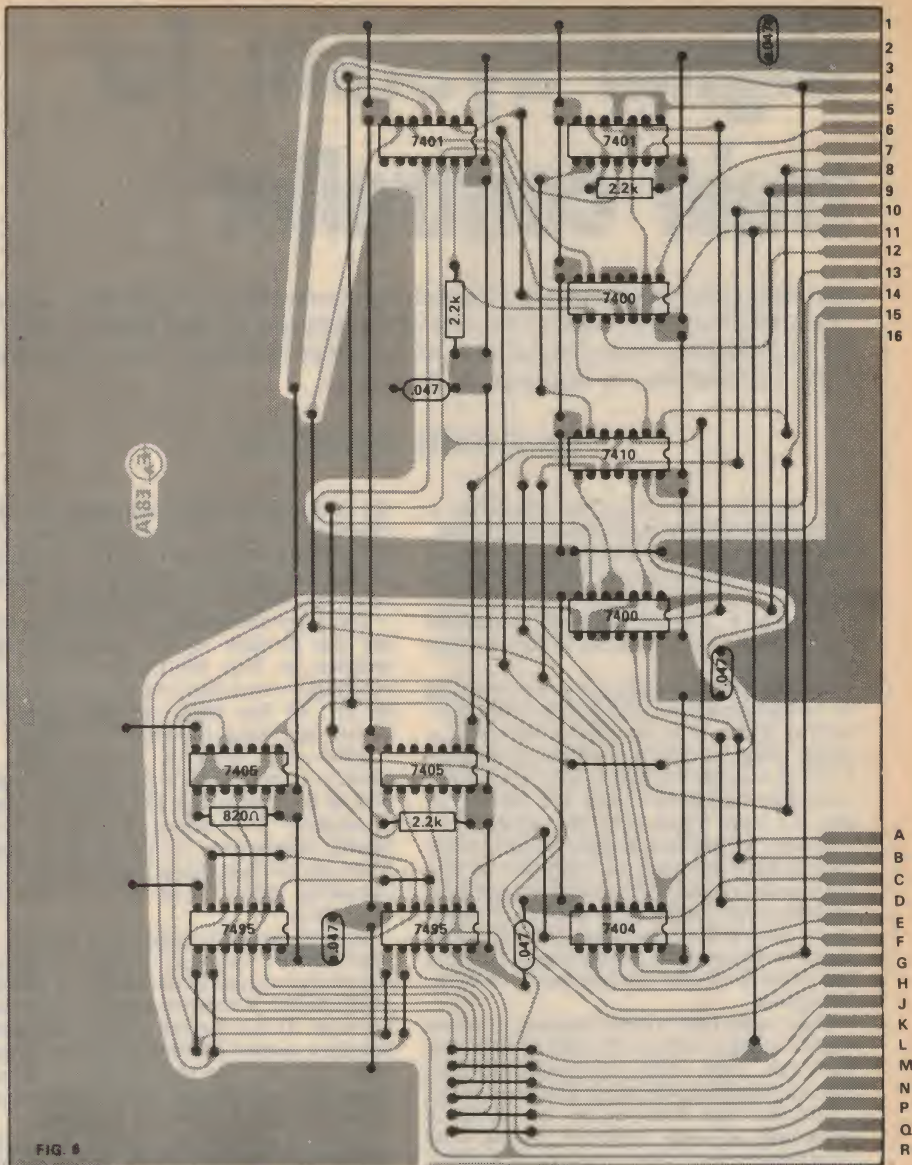


FIG. 6

PLEASE NOTE

In the initial explanation of EDUC-8 operation, it was stated that with a cleared AC register, the effect of the CMA microinstruction is to give the AC a content of 1. This is of course wrong; it leaves the AC with all bits set to 1, equivalent to minus 1 in 2's complement notation.

It should also be noted that the RAR microinstruction only corresponds to division by two when the initial AC register content is an even number — i.e., with bit 0 zero. This is because the content of bit 0 moves to the bit 7 position following RAR.

In Fig. 6 of the same section, showing the basic organisation of the machine, the inverter shown after gate 14 should be before this gate. The inverter is used for the CMA microinstruction.

Finally, please note that the PC and MA registers have now both been enlarged from 5 to 8 bits, to cope with the 8-bit address words required for the 128/256 memory.

Signal system for train controller

Here is a circuit to couple your model train controller to a signalling system. The full inertia characteristics are retained, producing a most realistic effect as the train decelerates and stops, then starts and accelerates to its original speed — all automatically in response to the signal.

by DAVID EDWARDS

In the May 1974 issue we presented a Model Train Control with Simulated Inertia. This was designed to overcome the lack of inertia in a model train, in both the starting and the stopping modes. We also incorporated a "kick in the pants" circuit to help overcome the problem of non-starting trains.

In this month's article, we are presenting an add-on circuit to incorporate automatic control of the train in conjunction with a signal. What we had in mind was to provide a switch to control a signal, and to have the controller interlocked with the switch, so that the train would obey the signal.

In fact, we had this thought in mind when we originally designed the controller. It was the reason we used the second change-over contact set on the "kick in the pants" relay to simulate setting the throttle to minimum speed. In figure 1, RL1 disconnects R1 from the wiper of R3 and discharges C2 (slowly) through it.

This means that a switch placed in series with the relay coil can be used to stop and start the train, with full inertia effects, without disturbing the main throttle setting.

Consider the case where the train is travelling at some arbitrary speed. The throttle will be at the appropriate setting, and the relay in the energised position. If the relay coil circuit is opened, the lower change-over set (Fig 1) will connect C3 to the positive supply rail via R7, charging it so that the kick in the pants may be applied when the relay is energised again.

The upper change-over set will effectively set the throttle to the minimum speed position, so that the train will slow and eventually reach the minimum speed as set on R4. At this stage we may apply the brake, and bring the train to a stop.

When the relay is re-energised, the throttle is returned to the original setting and, at the same time, the kick in the pants is applied. This starts the train, which slowly accelerates to its original speed. Thus the obvious place to interconnect our signalling circuit is in the coil circuit of relay RL1.

To stop the train completely after it has decelerated we may apply the brake manually but, fairly obviously, it would be much better if this also was an automatic function. This is not hard to arrange and is simply a second braking circuit in parallel with the first. The two circuits remain independent and we can make the automatic brake fiercer or softer as required.

The next problem is to sense the position of the train. Perhaps the simplest solution, and one that we have used in the past, is to use reed switches in the tracks in conjunction with permanent magnets underneath the trains. As the train passes over the reed, the contacts close for a short period. This is sufficient to indicate the presence of the train.

Since the reed contacts close for only a short time while the magnet is passing, it is necessary to provide some sort of latching device to "remember" the passage of the train. This can be done quite simply, in either of two ways. We have used both.

The first method is to have the reed operate an electromagnetic relay in the latching mode. The reed switch is connected in series with the coil of the relay, so that the relay is energised when the reed is closed. A normally open contact set (one that closes when the relay is energised) is connected in parallel with the reed, so that the relay will "lock on". Other contact sets are used to perform the required switching functions. The relay may be unlatched by momentarily opening the coil circuit.

The second method is based on the different pull-in and drop-out ampere turns of a reed switch. It is a characteristic of a reed insert that a larger value of ampere turns is required to operate the reed initially than is needed to hold it closed. With the reed we used, 30 ampere turns are required to close the contacts, but the contacts do not open till the field is reduced to 12 ampere turns.

This means that the reed will not operate in a 20 ampere turn field but if this field is reinforced by an external permanent magnet so that more than 30 ampere turns are present, the reed will close. When the external magnet is removed, the reed will stay closed. The reed is thus latched on, and the required switching functions may be performed by the closed contacts. The 20 ampere turn field is most easily provided by placing the reed inside a coil.

The basic circuit for stopping and starting the train is shown in Fig. 2. Connections between the controller and the auxiliary circuitry are via 5 pin DIN plug and socket. The socket was wired into the controller as shown in Fig. 1.

A dummy plug is used with this socket to connect points A and B together when the auxiliary circuitry is not in use. Alter-

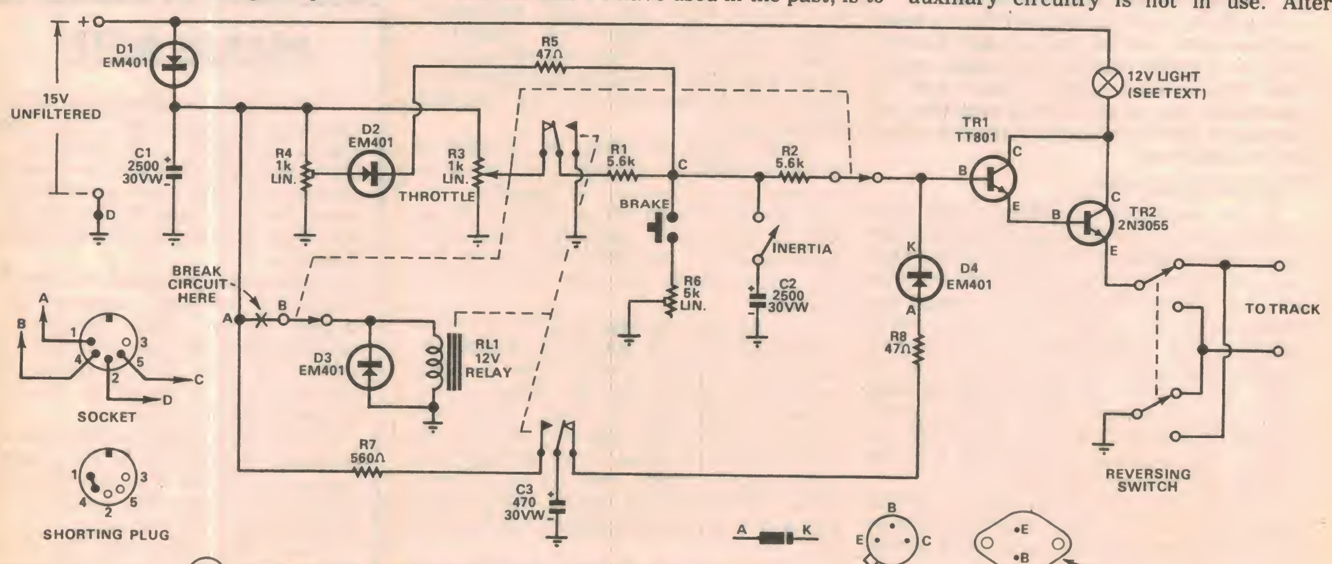


FIG. 1

TRANSISTOR TRAIN CONTROLLER WITH INERTIA
(MODIFIED FOR USE WITH SIGNALLING UNIT)

(FILE 2/MC)

This circuit is substantially the same as that published in the May issue. The main change is the addition of a 5-pin plug, wired as indicated by the letters "A", "B", "C", and "D". Note the break in the original circuit between "A" and "B".

natively, a switch could be used to perform this function.

When the STOP / GO switch (Fig. 2) is set to the GO position, the relay RL2 remains unoperated and points A and B are connected together. This allows the controller to operate normally.

Setting the STOP / GO switch to STOP commences the sequence of events to stop the train. When the train passes over the first reed switch, RS1, the magnet momentarily closes the reed contacts. This operates relay RL2 and a set of contacts on this relay shorts the reed contacts, holding the relay operated after the reed switch opens.

The relay coil current passes through a coil wound around the second reed switch, RS2. A preset pot, R9, is used to adjust the current to hold RS2 operated once it has been operated, but not sufficient, alone, to operate it.

When RL2 is operated, points A and B open. This interrupts the current to RL1, which switches the train to its decelerating mode, as explained earlier. The first reed switch, RS1, is positioned so that, by the time the train is approaching its intended stopping place, it has slowed to its minimum speed.

When the train reaches the second reed, which is placed just before the intended stopping point, the magnet closes the reed, which latches on. This connects R10 across C2 (Fig 1) and brakes the train to a standstill. R10 is adjustable, to allow for variations between trains.

To start the train again, the STOP / GO switch is set to the GO position. This opens the circuit to the coil of RL2 which, in turn, supplies power to RL1, and initiates the kick start of the train.

When we tried this circuit we were very impressed with the realism of it, except for one thing. When the signal arm was lowered the train started immediately, almost before the arm had finished its movement. Since, in real life, there would be considerable reaction time on the part of the driver, we sought to simulate this.

The solution was relatively simple. A large electrolytic capacitor is wired in parallel with the coil circuit of RL2. This delays the relay dropping out when the signal is set to GO, so that the train does not start for about one second after the signal has operated. The effect is very realistic. The capacitor has no effect when the signal is switched to STOP.

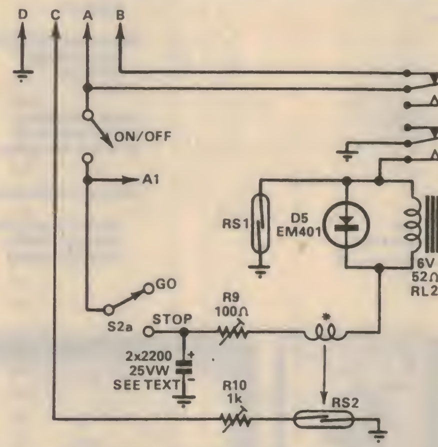
Much of the experimentation involved in developing this system was concerned with finding a method to reliably operate our signal, using a simple two position switch. Here we will digress to explain the operation of the signal unit itself.

The signal consists of the usual moving arm type indicator, operated by a lever inside the mast. At the bottom of the mast is a centre-tapped coil. Inside the coil is an iron core, attached to the operating lever. When the upper section of the coil is energised, the core is drawn upwards, and the lever moves the signal arm to the GO position. When the lower section of the coil is energised, the core moves downwards, and the signal arm moves to STOP.

The mechanical parts of the system are purposely made so that a small amount of friction is present. This means that, once the signal is moved to either of its positions, there is no need to keep the coil energised. In other words, the signal is essentially an impulse device, and does not require power to be applied continuously. In fact, continuous power would be detrimental to the coil.

Our problem was to relate these requirements with those of Fig. 2, assuming that contacts S2a were operated by the same switch mechanism as that used to operate the signal. Whereas the stopping and starting circuitry requires the switch to remain in one or other of its two positions, the signal requires only a fleeting contact or other pulse generating circuit.

The circuit we evolved does this quite well. It uses two poles of a three pole two position switch, connected as shown in Fig. 3. With the switch in the position shown, C4 is charged via D6 and R11. The bottom



*330T. 36 B & S ENAMELLED COPPER WIRE, WOUND IN TWO LAYERS ON REED, EACH APPROX. 20mm LONG.

EA SIGNALLING CIRCUIT

FIG. 2

How the sensing reeds and the control relay are connected. RS1 initiates the slowing down action, RS2 operates the brake.

section of the coil has a small current passing through it, as determined by R12 and R14 in series. This is not sufficient to operate the signal, which would be in the STOP position. C5 is charged only to a small potential, as the ratio of R12 to R14 is large.

When the switch is moved to GO, C4 discharges via R13 through the top of the coil. This moves the signal to the GO position. At the same time, C5 is charged via D7 and R12, ready to return the signal to the STOP position. Diodes D6 and D7 isolate any pulses which appear, by transformer action, at the opposite end of the coil.

Resistors R11 and R12 are necessary to isolate the supply rail (A) from the signal coils. They restrict the charging rate of C4 and C5 but, with the values shown, maximum operation rate of the signal is about once per second; plenty fast enough for any likely situation. Resistors R13 and R14 limit the maximum current through the switch contacts during the discharge of C4 and C5. They also prolong the pulse in the coil, giving a smoother action.

We combined the stopping circuitry and the signal control circuitry in the one unit. We used a three pole two position switch; two poles to control the signal, and the remaining pole to actuate the stopping circuit.

Our signal was fitted with a small lamp, which we wired as shown. We have not given a value for the associated resistor, as this will depend on the rating of the lamp. We also included an ON / OFF switch (Fig. 2) to disconnect the signalling circuitry.

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1% scale variation:	Approx. 30 sec.

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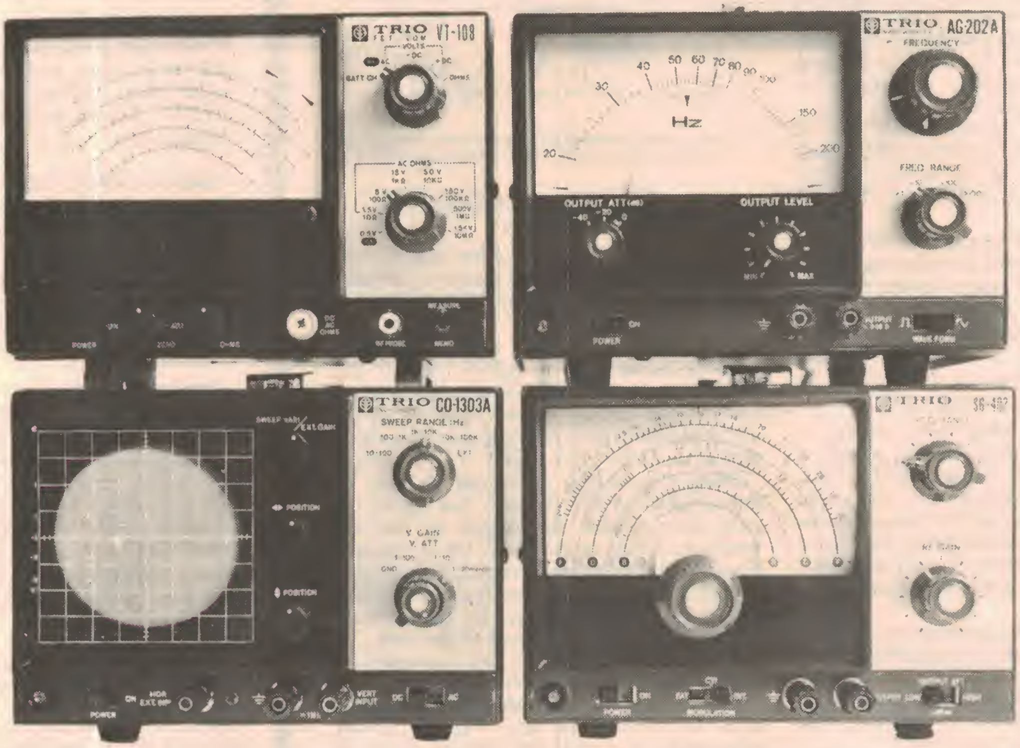
Output voltage:	10 Vp-p
Overshoot:	3%
Sag:	10% at 20 Hz
Output impedance:	600 Ω
Output attenuation:	HIGH/LOW (40 dB) and variable control
Drift with line voltage:	(±10% variation) Freq: ±0.5% Level: ±0.5 dB
External synchronization:	
Synchronization voltage:	1%/V approx.
Max. input voltage:	3 V r.m.s.
Input impedance:	10 kΩ



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Vertical Sensitivity:	20 mV/cm
Attenuator:	1/1, 1/10, 1/100 plus fine control.
Bandwidth	DC: DC to 1.5 MHz (−3 dB) AC: 2 Hz to 1.5 MHz (−3 dB)
Input R and C:	1 MΩ, 30 pF
Max. input voltage:	300 V (DC + AC peak) or 600 V p-p
Horizontal Sensitivity:	500 mV/cm
Attenuator:	Continuously variable
Freq. response:	DC to 250 kHz
Input R and C:	1 MΩ, 40 pF
Sweep Freq:	10 Hz to 100 kHz in 4 ranges
Synchronization:	Internal (−)
Power requirements:	100/117/230 V AC 50/60 Hz, 15 W.

SG402 R.F. Generator $66★

Freq. range:	100 kHz to 30 MHz in 6 ranges
Freq. accuracy:	±1%
Output Voltage:	0.1 V r.m.s.
Attenuator:	HIGH/LOW (10:1) and variable control.
Modulation:	
Internal:	400 Hz, 40% mod. degree
External:	Requires 1.5 V r.m.s. for 40% mod. degree
Power requirements:	100/117/230 V AC 50/60 Hz. 6 W.
Dimensions:	W 186 mm x H 131 mm x D 220 mm (W 190 mm x H 154 mm x D 245 mm Max. dimensions)
Weight:	2.5 kg

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This switch controls the power to the signal, the signal light and to RL2.

The next point is the relative positions of the signal and the associated reed switches. We placed the signal just before a set of points. The first reed switch, RS1 was placed about 4m before the signal, while the second reed switch, RS2 was placed about 0.25m before the signal. The reeds were placed at right-angles to the sleepers. As RS2 has a coil wound on it, it was necessary to cut away some sleepers so that it could be lowered, otherwise the train would not clear it. This also helps conceal the reed.

We positioned the magnet under the tender of the train, as this was the most convenient location. We used a cardboard spacer, and glued it in position so that the magnet was just above axle level.

The coil on RS2 was made from approximately 330 turns of 36B&S enamelled copper wire, wound in two layers approximately 20mm long. We used the reed itself as the former, and held the wire in place with tape. We did not count the turns, but wound on as many as would fit on the two layers. The wire size is not critical, but should be as small as possible, as this makes the coil easier to conceal.

Once construction is complete, testing can commence. Place the ON / OFF switch in the OFF position, and check that the controller operates normally. If it fails to do so, the most likely cause is an open circuit in the coil circuit of relay RL1. Check that there is a continuous circuit from point A in figure 1 through the connecting cable and the contacts of RL2 back to point B.

Remove the train from the rails. Place the ON / OFF switch in the ON position, and operate the STOP / GO switch. Check that the signal arm moves, and that it is in phase with the switch. If not, reverse the connections to the ends of the signal coil.

Next, adjust R9 for correct operation of reed switch RS2. Switch to the STOP position, and push the tender by hand over the first reed switch, RS1. RL2 should operate, and remain energised after the tender is removed. If it fails to do so, check that R9 is in the minimum resistance position.

Disconnect the wire from the end of RS2 nearest to R10, so that RS2 is isolated from any voltages, and connect an ohm-meter or similar device across it. With R9 in the minimum resistance position, the contacts should close. If not, then either more turns will have to provided, on the coil, or a lower resistance coil used with RL2.

Slowly increase the value of R9 until the contacts open, and then decrease the value by a small amount. Push the tender over the reed RS2 and associated coil, and check that the contacts close and remain closed. If they fail to do so, reverse the tender and try again. This is necessary because the magnet in the tender will assist the coil in some positions and hinder it in others, as it moves over the coil. The polarities must be arranged so that the final influence of the magnet is to assist the coil.

If, when the tender (and hence the magnet) is reversed, the contacts stay closed, then either the magnet or the coil will have to be reversed.

If reversing the tender does not close the contacts, decrease the value of R9 and try again. This process will have to be continued until the reed will reliably latch-in when the tender is pushed over the reed.

Set the brake resistor, R10, to minimum resistance and set the signal to GO. Place a train on the rails, and allow it to run at the usual maximum speed. At a time when the train is just about to cross the first reed, change the signal to STOP. When it passes the reed, the relay RL2 should be heard to operate. The train should then commence to slow down.

Provided there is sufficient track, by the time the train reaches the second reed, RS2, it should be travelling at it's minimum speed. When RS2 latches on, the train should stop immediately. If it fails to do so, R9 will have to be re-adjusted. Once it has been verified that RS2 is latching on, R10 may be adjusted to give a more realistic braking performance.

We found that we could adjust R10 so that the train would stop right at the signal. The final effect of the complete circuit was very impressive. If the reeds are concealed, the train appears to stop in quite a realistic way, giving the impression that it really is controlled by a driver in the cab! The delay on starting produced by the capacitor in parallel with RL2 adds to this impression.

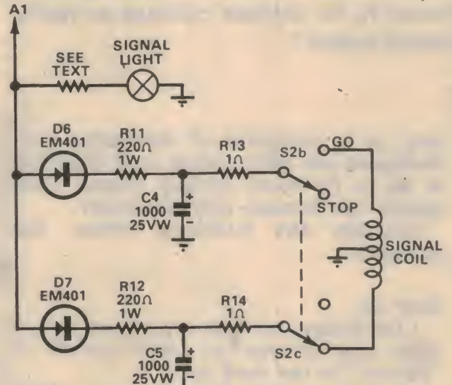


FIG. 3

The signal operating circuit. Switches S2b and S2c are mechanically coupled to S2a in Fig. 2. The signal light is optional.

Forum

Conducted by Neville Williams

"Electronics Without Tears": no such thing!

Electronics is a fascinating subject, but it is also one which demands some deliberate study if one is to understand basic concepts. Much of it defies explanation in lay terms and there are certainly no capsule courses or ready reckoners which can turn one into an "instant expert".

We are reminded of this fairly frequently in the editorial offices of "Electronics Australia". Faced with a particular technical problem, people who have seen the magazine on the news-stands hopefully seek our guidance — and interpretation!

The "routine" is to tell us about their particular problem, with the idea that we will explain the technicalities of it to them in terms that they can understand. So equipped, they hope either to be able to cope with it themselves, or to keep a close eye on the person who ultimately does the job, making sure that it is performed efficiently and economically.

In many areas, outside electronics, the approach works fine. If the paint on your house peels, there may be complex technical and chemical reasons why it does so. But inquire of the appropriate paint company and they will usually nominate the cause and the most likely way to overcome it. They may use some big words and unfamiliar chemical terms but the average layman has no great problem in getting the message.

Electronics isn't like that. At least, much of it isn't.

The other day, for example, I heard a member of our staff trying to explain to a non-technical friend about standing wave effects in a TV antenna system — presumably responsible for ghosting on the screen. The friend was thoroughly puzzled by the idea of hanging a bit of "spare" TV ribbon on the receiver aerial terminals.

You can't talk about this subject for too long without unearthing an anachronism. Connect a length of 300-ohm ribbon across an antenna feed and it will look like an open circuit at certain frequencies — provided you short the far end! If you want it to look like a short, you must leave the far end open.

To anyone familiar with ordinary electrical wiring, these statements look like nonsense. They aren't, of course, but there's a fair slab of theory between simple electrical circuits — the kind of thing a layman can grasp — and the standing wave patterns and impedance characteristics of a radio frequency transmission line. You simply can't compress it into a few words, no matter how well chosen!

Not everyone is prepared to accept such a comprehension barrier. They may well conclude that their would-be informant is lazy, or is incapable of translating gobbledegook into plain speech, or is unwilling to do so for some devious reason. Both parties can become very frustrated.

Consider the following letter, for example:

Dear Sir,

I had hoped that you might continue on from your analysis of tricky circuits in "Forum," in the April issue.

A lot of people building circuits want to know how to arrive at the right value for the various components, for example.

Again, circuits are required to work at higher and higher frequencies and hobbyists require a series of simple guides as to how to stabilise many of them. How do you choose between capacitive, resistive and inductive feedback once a circuit shows signs of instability? When do you lay blame on the circuit or on mere lack of shielding?

Recently, I noticed a cascode circuit in a Philips book on field effect transistors, where they say that the transistors must have sufficient voltage to produce saturation; they put 30 volts across the two. Yet I've had a single transistor working very satisfactorily on only 1½ volts. Why more when they are combined? With me, it produces only instability and cross modulation.

Also in the Philips book is a circuit for a CRO preamplifier. The first transistor has a small capacitor and resistor from the gate to earth. Does this act as peaking or stabilisation, and when should it be used?

I think there are a number of ways in which problems like these could be explained.

For instance, when your technical men are describing circuits, they could also explain some of the circuits that did not work!

F.F. (Dundas, NSW)

Without getting involved in every detail of the letter (which we've abbreviated somewhat), F.F. is obviously in the position where most of us have been at one time or another. Dare I admit that most of us are still in an equivalent position in relation to electronic equipment which we do not, as yet, understand.

We'd be delighted if someone could show us a way through the intricacies of the particular subject, obviating all the time and tedium that might otherwise be expected.

Sadly, "instant knowledge" is seldom available that easily. I recall that once-famous book "French Without Tears", which I encountered in first year high school. I didn't suffer any tears, but I didn't acquire much French, either!

Getting back to the letter, F.F. looks at typical circuits and sees an array of components, each marked with a specific value. Surely there must be some conventions, some rules which govern the choice of these values. Surely it must be possible to produce a summary, a digest, a table, a graph, which could serve as a painless guide to the enthusiast in nominating his own circuit values. Why don't we present something like this in "Forum", or elsewhere?

Perhaps an enthusiast should be excused for doubting a reply to the effect that there can be no such source of instant knowledge; for concluding, as we have suggested, that his informant doesn't care, or is lazy, or has some selfish reason for withholding the information!

In fact, the values of components which occur in the broad spectrum of electronic circuits depend on so many interlocking factors, that they cannot be reduced to a simplistic choice. By the time a person has learned enough to identify and interpret all the factors, he probably won't need to ask the question!

It boils down to something like this; If you want to be an expert, all you need is an understanding of the relevant theory!

This sounds glib, smug, evasive and frustrating in the extreme. The sad fact is that it happens to be true!

Let's say, for example, that you wanted to specify the appropriate value, rating and type for a capacitor in a circuit — any circuit. We begin by asking some quite essential questions:

ROLE: Is the capacitor in a signal coupling path, a signal bypass path, in a resonant circuit, or part of the power supply system? These are obviously terms here which the enthusiast must understand and be able to resolve before he can move to next base. He must know enough about circuits to see what is going on and the part played by the various components — in this case the individual capacitors.

FREQUENCY: What range of frequencies does the capacitor have to deal with in its particular role? Are there frequencies which it need not, or should not pass outside the essential spectrum? If a resonant circuit, is it associated with an inductor, or distributed inductance, or a particular R/C configuration? These questions are condensed for the sake of brevity, but they obviously require of the enthusiast a further and substantial order of technical perception — but there is more to come.

IMPEDANCE: What is the impedance of the circuit with which the capacitor is associated in its particular role? Now we are getting in really deep. The impedance cannot be discovered by looking at the value of adjacent resistors. It may involve the output and input impedance of transistors or other active devices, which depends in turn on their operating configuration. In power supply circuitry it will involve a consideration of apparent source impedance as well as the apparent load impedance determined by the operating voltage and current.

These things are not said to confuse. The simple fact is that it is not possible to

nominate a value for a capacitor in a circuit unless you can understand its precise role in that circuit, the frequency band over which it must function in that role, and the related circuit impedances.

But even then, the job is not finished. Further knowledge — or background — has to be invoked to suggest the general type(s) of capacitor which would be suitable for the role, the peak and/or working voltage rating necessary and even the peak current rating in certain applications.

As we said earlier, if an enthusiast can analyse an application to this extent, it is unlikely that he will be asking the kind of question with which we started out.

What is true of capacitors would apply even more to active devices. By the time one gets to understand the operating voltages and currents of transistors, circuit configurations, input and output impedance, gain, frequency pass band, stability and so on, one is well on the way to "getting the game by the throat".

To be sure, one would not need the whole bit to come up with a reasonable answer to the problem raised by F.F. but there is still an enormous comprehension gap between the answers and the question as posed. That gap is not going to be bridged by any kind of capsule treatise.

Then there's the matter of circuit instability, which has bugged most of us at one time or another in our creative moments. For the writer, the problem goes back to my earliest efforts with triode detectors and RF amplifiers. But it's as recent as a regulated power supply which seemed determined to oscillate at some ridiculous high frequency!

How do you diagnose and correct instability? Certainly not by looking up a chart or applying one of a number of stereotyped rules.

You try to verify that the gadget is unstable, try to get some idea of the frequency and observe whether it is sensitive to any particular operating situation. Then you have a good look at the circuit and try to imagine what unforseen circumstance could possibly produce that annoying condition. Having evolved a theory, you try to work out what might defeat the effect. If the remedy works, fine! If it doesn't, you try again!

The whole procedure depends on one's ability to analyse a circuit or a piece of equipment well enough to appreciate what might be happening and what could logically be ecpected to correct that condition. Again, that kind of knowledge and approach can't be compressed into capsule form!

There is only one way for F.F. to come to grips with electronics and to begin to comprehend its intricacies.

He must get hold of a textbook like our own "Basic Electronics", and start with the electron in chapter 1.

He won't find a precise answer to his immediate questions but he will gradually acquire a background from which the answers to many questions will emerge. It's a much surer method than relying on discussion of random and assorted items in some variation of the "tricky circuits" theme.

Just to anticipate a possible counter argument, it might be suggested that servicemen — and others — do build up a set of "home grown" conventions that seem to replace circuit analysis.

Faced with a leaky audio coupling capacitor in a valve TV set, a serviceman might not think too hard about the value. If he doesn't have an identical component, he knows that "it'll probably be okay if I stick in a 400-volter between about point-02 and point-1."

Faced with a similar situation in a transistor set, he'd probably opt for an electrolytic of 1uF or more at about 20V.

Two things can be said about this:

(1) The serviceman may not be a whizz at basic theory but there is still an acquired background to the decisions he makes. The wider that background, the more competently will he be able to cope with unfamiliar faults and unfamiliar equipment.

(2) Servicemen and others do evolve conventions and routines through constant exposure to similar situations. Show them a problem and they'll come up with the matching answer. But a serviceman who has a repertoire of problems and answers, and nothing more, faces a bleak future as we move into solid state and colour . . .

That is, unless he parallels what we've already suggested for F.F., getting back to the midnight oil and some basic theory. There's no "instant knowledge" for colour TV servicemen, any more than there is for enthusiasts.

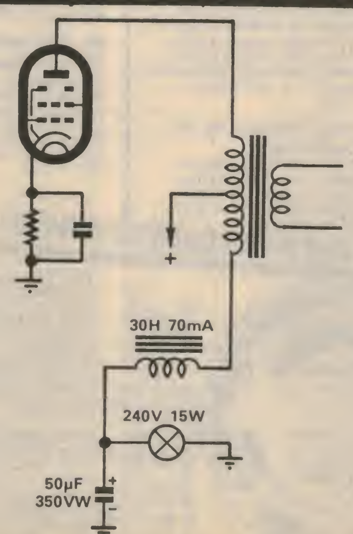
Sorry, F.F. EA

Dear Sir,

I refer to the Forum item in July '74 and matters stemming from the "Barnes Mystery" hoo haa. Your comments on DC balance are correct but there's one balance mode that allows one to have one's cake and to eat it as well.

Some years ago, I had the problem thrust on me gratis of fixing an amplifier that sounded "tinny". To cut a long story short, the amplifier had a single 807 feeding a push-pull transformer with no air gap and intolerant of DC unbalance. Hence, saturation, low inductance and poor output at low frequencies. Since it was out of the question to buy a new transformer, it was necessary to think up a way to balance the DC while isolating the AC loading.

Three cheap components, an oddment filter choke, a filter electrolytic and a 15W / 240V lamp were installed. It worked like a charm B. B. (Indooroopilly, Qld.)



Dick Smith Ele

Have A Happy Kitmas

We don't claim to have a kit for everything, but what we do, we do well. By keeping in close touch with the magazines you can be sure that these kits are bang up to date. Note we do not supply copies of articles unless requested and these are 50 cents extra. Prices range from under $5.00 and there's something for everyone.

No. 2 100W Guitar Amp ET1 413 December 1972

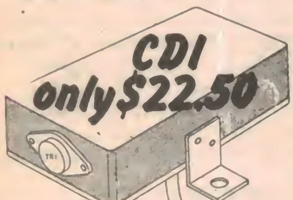
This is THE Guitar Amplifier. A full 100W RMS at 0.5% distortion from 20HZ to 20KHZ with a 4 ohm load. Connect as many speakers as you like as long as the combined impedance is more than 4 ohms. Input impedance 4.9 Kohm. Extremely rugged construction. $75.00 (P & P $2.00).

No. 2A 100W Guitar Preamp ET1 419 September, 1973

Designed to match the ET1 413. Has two inputs, 2mV at 1K and 20mV at 47K. More can be added if you wish as the unit has mixing facilities and can be either built into the 100W Amp or used separately. Kit is complete with bass and treble controls. **$13.50** (P & P 75c).

No. 9 Capacitor Discharge Ignition E.A. August, 1970

Get the best out of your car's engine. Fit this C.D.I. It will suit 12 volt systems, positive or negative earth. A well proven unit designed to give you the "mostest for the leastest". $22.50 (P & P $1.00).

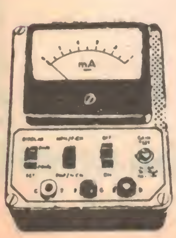


No. 11 Playmaster 143 Hi Fi Amp E.A. September, 1974

This unit is an improved version of the Playmaster 136 of which over 10,000 have been made. 12½ Watts per channel into 8 ohm at a typical 0.4% THD and within ±2dB from 20HZ to 20KHZ. Inputs are 2mV into 50K and 150mV into 500K. Noise figures 60dB down with all input open and 44dB X talk. An excellent unit which has been designed so that conversion to 4 channel can be made with a minimum of fuss. Ideal for the home environment and has provision for headphones. **$79.00** (P & P $3.00).

No. 14 Transistor Tester E.A. August 1971

A very simple project which will enable you to test any of your transistors including FETS. Uses only a handful of parts but the performance is better than many commercial units. It is so easy to build and operate that no serious electronic hobbyist should be without one. Ideal for use by schools also. Runs off its own 9 volt battery. **$18.00** (P & P 75c).



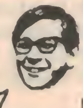
$18

No. 42 Varilight 1000W Dimmer E.A. April, 1973

Turn down the lights with this simple unit. Easy to build, easy to use, guaranteed results! The demand for this unit has been amazing. Many people have bought this unit so that they can set the background room lighting for watching T.V. This unit connects directly to the mains and should ideally be fitted by an electrician.
NOTE: Tinplate for chassis not included. **$7.50**.

No. 45 Dick Smith Decision Maker

Yes or No? To be or not to be? That is the question. The Dick Smith Decision Maker will give you the answer at the push of a button. We designed this one especially for the vacillating businessman who has to make quick decisions but is plagued by indecision. Use it in the office, at home or going shopping. It uses two LED display and 3 transistors and runs off a 9 volt battery. Fully self contained **$8.75** (P & P 75c).



No. 47 Musicolour MKII Colour Organ E.A. December, 1972

Add an optic dimension to your hi fi. Enjoy the added effect of coloured lights varying in intensity and contrast in co-ordination with the frequency and best of your music. The unit, which runs off 240V divides the music into three broad frequency bands and there modulates three separate light "channels", of up to 1000W each. By changing the settings on each channel you can compose many different light concentos using the same piece of music. Can be used with any sound source capable of running phones. Works on voice too. Light up with your favourite radio announcer or commercial!

No. 67 Ultrasonic Transmitter E.A. February, 1974

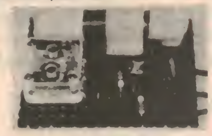
Based on our own imported Ultrasonic Transducer No. 105 and designs published in E.A. February '74, this little unit together with the Kit No. 68 Ultrasonic Receiver can be used as a door-way monitor or a burglar alarm system. It could also be used for remote control of various devices or even counting guests at a party — runs off a 9 volt battery. **$11.50** (P & P 75c).

No. 68 Ultrasonic Receiver for the Ultrasonic Transmitter

Designed basically for relay operation but can be altered to virtually any form of readout. It now includes our super-sensitive transducer. Runs off a 9 volt battery. **$17.50** (P & P 75c).

No. 69 ZN414 Receiver E.A. May 1974

The ZN414 is an I.C. which requires only two resistors, two capacitors, tuning gang and coil. 1.5 battery and earpiece to become a transistor radio. It can truly be built in a matchbox yet will give performance which will astound you. Can you afford not to build one! Includes all electronic parts and free circuits. **$6.75**.



No. 71 ET1 422 Stereo Amp Complete

"BEAT THIS SUPER KIT VALUE" WITH OUR EXCLUSIVE FIBREGLASS BOARDS.

SPECIFICATIONS
Power output 50Wrms Frequency Response ±5dB from 20Hz to 20kHz. Channell separation 45dB. Hum & Noise — 78dB (aux) — 67dB (disc) Input sens. Aux 210mV Disc 2.1mV, Main amp 500mV. Distortion (10W) 0.16% Tone controls ±13dB. Damping factor >70. PCBs in fibreglass throughout. Handsome teak cabinet. Full instructions.

This stereo amplifier kit is complete in all details and conforms with the E.T. design of May 1974. A guaranteed 50W RMS per channel into 8 ohm loads, from 20HZ to 20KHZ at 0.5 dB. Distortion less than 1%, typically 0.15%, many facilities including tape, tuner mike inputs, preamp output, main amp input at 3 basic sensitivities of 2.1mV, 210mV and 500mV. Kit comes complete in every way. Definitely the best build-it-yourself amplifier available and equal to many commercial units costing three times as much. Purchase the complete kit or build in these last stages. **$135.00** (P & P $3.00).

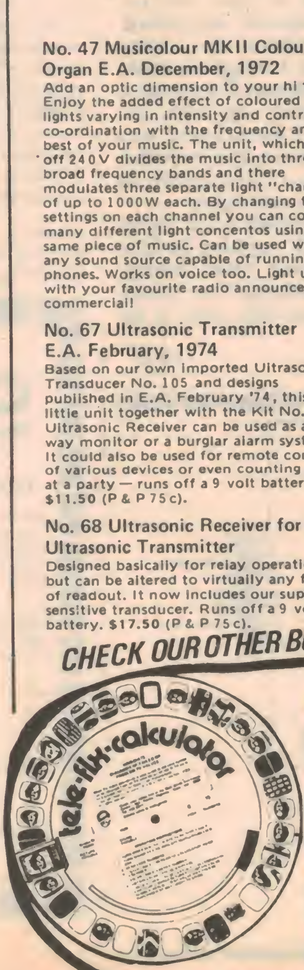
No. 105 1.5 Watt Amplifier ET1 225 E.T. May 1974

A small amplifier is virtually indispensable to the experimenter. Can be used as an amplifier, signal tracer, monitor etc. Its uses are innumerable. It is very easy to build, is not very particular as to layout and extremely low priced. Runs off 12 volt D.C. **$4.90**.

No. 106 Temperature Meter ET1 226 E.T. May 1974

An extremely simple "press to read type" temperature monitor. Ideal for use with a number of sensors in different localities e.g. pools, outside temperature, inside temperature etc. Range is from 0°C to 100°C. Runs off 9 volts. **$10.75** (P & P 75c).

CHECK OUR OTHER BUMPER ADVERT!



Don't forget a Telefix. If your set goes on the blink over the holiday period, how long will it take to get a serviceman? Anyone can locate 90% of faults caused by valves with Telefix. Only $2.50 (P & P FREE).

Tools are a natural for Christmas. Check the catalogue for our wide range, but why not a new pair of pliers or cutters from Fuller at only **$3.00** approx. 4" long and a choice of 5 pliers or cutters?

Dalo pen for your PC tryouts. Ink is immune to etch so simply draw your pattern, proceed as usual then use solvent to clean tracks up. Pen **$1.75**, solvent **85c**.

Going away for a holiday? Then hurry and get a **Watchdog** installed. From the same manufacturer as Cargard, here's a complete alarm system for your home. Uses modules comprising alarm and separate siren, plus speaker and 3 reed switches. No soldering, runs off 12V battery **$46.00**, or with 5 reed switches plus pressure mat and tape blocks etc. for **$64.00**.

For The Christmas Stocking

Add a tweeter to your system for only **$9.50**. Phillips AD061/T8 handles 20W and covers 1.5 kHz to 22 kHz (full instructions in our cat.).

Battery Charger 4 from A & R has dual ranges – trickle or 4 A, immune to shorts or accidental reverse connection. Charges both 6 and 12V batteries. Handsome tough case with meter. The best around at only **$24.00** (P & P $1.50).

CIS460 Headphones feature the very latest styling with Mylar power cones giving a frequency response from 30 to 20,000 Hz. Independent volume controls built in. Only **$14.95**.

Electric Car Aerial adds a touch of class to your humble motor. Push the button and up she goes to an enormous 43". Suits 12V supply of either polarity. 12" underhang. Only **$21.00** (P & P $1.00.)

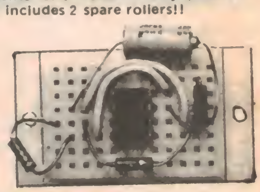
Car Stereo Speakers SKA046 requires only 2½" depth, nominal 6" diameter handles 5W, response from 130 Hz to 9 kHz **$16.00** a pair (P & P $1.00).

ES70S Magnetic Cartridge improves the sound from your record player (if amp is sensitive enough). Response to 25 kHz. Tracks at only 2 gm. Fitted with diamond stylus and value at **$8.75**.

Shure cartridges M75 only **$13.50**, M55E **$14.99**, M91ED **$28.00** or if you're really flush V15 MkIII at **$69.95**.

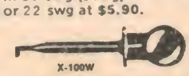
Tape hobby boxes by BASF for reel to reel or cassette (specify) only **$7.50** contain splicer, blades, leaders, labels, etc. etc. Edit all your tapes for the parties.

Record Cleaner. When you consider the work they do for such a low price, you'll wonder why you didn't get one before your precious records got ruined. Don't spoil your Christmas record presents for the sake of only **$3.90** and that includes 2 spare rollers!!



Mini IC Socket from EI instruments for your IC lashups. Gives them a better chance of working for only **$3.00** and saves so much frustration. Or blow **$26.00** on the proper breadboard. Both operate to 30 MHz.

Pop a box of **solder** in. Ersin Multicore **$4.40** in 16 swg (500g) or 18 swg at **$4.50** or 22 swg at **$5.90**.



X-100W

EZ Hooks are handy for your test leads at only **$1.65** or the Mini at **95 cents**. Or how about a scope probe case from EZ at **$1.60**?

Perhaps your main Christmas present is a new car (ha, ha). Even if it isn't protect your vehicle with a **Cargard RB200** which is easily installed by any handyman. Highly recommended and supplied complete with horn at **$37.50**.

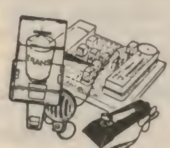
ctronics Centre

Here's the best way to learn-

EDUCATIONAL KITS

Experimenters kits have always been popular with beginners. They make ideal Christmas presents for young and old alike. This year we have the new Denshi Block kits which use plug in type modules as well as the Science Fair wire link type kits. All are highly recommended and some are used in schools. Circuits can be used over and over again. All are completely safe operating from low voltage batteries (extra). Get a kit and a basic book and you're on your way to becoming another boffin!

CRYSTAL RADIO KIT. This easy to build radio uses the same circuitry developed by Marconi for the first radio transmissions . . . an ideal introduction to basic radio theory for tomorrow's engineers. It will receive all local radio stations, no battery is required and it takes only an hour to build. Dimensions 11" x 8" x 1½". **$3.95** (P & P 30c).



NEW DENSHI MODULES

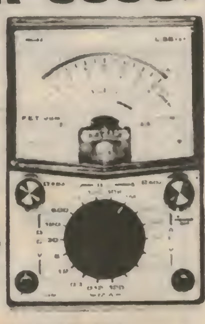
Denshi ST45 features a build-it-yourself radio. The circuit board has been built into a transistor radio case with a ready built amplifier module complete with loudspeaker. The module has a 3 transistor push-pull amplifier with volume control and 9V battery. 22 modules are included which will make 45 circuits ranging from radio circuits, morse code trainers, bird simulator, metronome, even a spy radio bug! Components include transistors, diodes, transformer, morse key, mic, earpiece etc. 80 page manual and neat radio case all for **$16.50.**

Denshi SR3A. The giant kit with 105 experiments, reflex radios, record player amplifier, wireless mic, burglar alarm, photoelectric warning device etc. This one has a 3 stage circuit board and special control panel with speaker switch, volume control etc. plus separate extension speaker for intercom etc. Solar cell included plus 46 modules morse key, earpiece, mic etc. Supplied with descriptive manual and excellent value at **$24.40.**

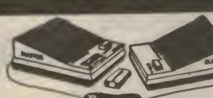
150 IN 1 EXPERIMENTER'S KIT — THE ULTIMATE
A magnificent educational kit for both the inexperienced and advanced experimenter. Beautifully detailed manual describes in step by step instructions, how to make up to 150 different electronic projects. No soldering is required and the complete kit operates off harmless low voltage battery power. An enlarged transparent I.C. (integrated circuit) clearly shows the electronic layout of these most complex space age devices. As no soldering is required (connections are by spring terminals) all components can be re-used time and time again. The kit includes the following electronic devices:— Cadmium sulphide cell, solar cell, micro-ammeter, radio tuner, potentiometer, relay, I.C., speaker, signal light, microphone, earpiece, morse key, slide switch, transformer etc. The separate projects are too numerous to list however, it has been said that the only thing that cannot be made is a television set! Supplied in a sturdy compact wooden case. Dimensions 16" x 8½" x 3½". **$35.95** (P & P $2.00).

CHRISTMAS SUPER-SCOOP

SAVE $10 on FET meter 100 only



We have 100 only **Jayem L55 FET Multitesters** for the real enthusiast at a knockout price. You'd normally pay the same for an ordinary meter but this one has 27 ranges, constant 10 Meg input impedance, battery operated and complete with vinyl case. The best Christmas gift at a saving of $10. Yes the L55 is yours for only **$33.50.** (P & P $1.00). But hurry. Special probes available too.



KE117 2 station is a highly efficient solid state intercom capable of working over distances to 500 ft. Wall or desk mounting. Master has volume control. Supplied with 50 ft. cable. Normally $13.50. 100 only reduced till Christmas to only **$10.50.** Save $3.00.

New PAL Book

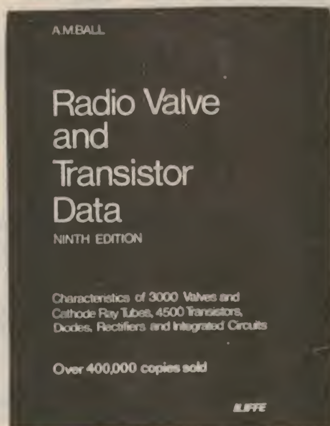
At last an Australian PAL book
PAL Colour TV for Servicemen by Cook, Wren 248p **$15.00.** This is a must. Written by an Aussie, this is the best book on Aussie PAL (and N.Z. too). Assumes B & W experience and covers theory in a not too technical way. Practical approach to solid state and IC circuits. Very thorough with heaps of diagrams, many in colour. Well written by a man with 30 years experience who set up training courses here.

Projects and Circuits from Electronics Australia $2.00. It's a beauty, all the popular tried and tested circuits from EA: Reaction timer, tape amp, bongos, microradio, train controller, tuner, novelties etc. etc. There's over 30 projects and 112 pages for only **$2.00.**

R. F. Probe $9.50. Temperature probe normally $11 now **$6.50,** 30kV probe normally $11 now **$5.** These are genuine reductions for the first 100 lucky customers.

BOOKS

RADIO VALVE AND TRANSISTOR DATA, A. M. Ball, 240 pages. Characteristics of 3,000 valves and cathode ray tubes, 4,500 transistors, diodes, rectifiers and integrated circuits. Contains symbols and abbreviations, explanation of tables, valve data, semiconductor device data, base diagrams, trade names and indexes. **$2.70.**



COLOUR TELEVISION THEORY G. Hutson, 326 pages. This book assumes the reader to have a working knowledge of monochrome television principles. It deals almost exclusively with the PAL system, but a chapter is devoted to the NTSC system. The text begins with an easy read chapter on "light" physics to give the reader a basis on colour mixing, chromaticity diagrams etc.; the principles are dealt with step by step in an easy to understand form. Practical circuitry and diagrams accompany the text, to give an interesting explanation. Colour plates are included to show relevant colour information. A chapter is devoted to transmission, and describes the difference between PAL, NTSC, and SECAM. In all, a complete, thoroughly absorbing easy to read text. This book is not only a must for all television technicians but of enormous interest and value to all interested in colour television. **We are getting entire Australian shipment, so this book is virtually available only from us. $12.50.**

110 IC PROJECTS FOR THE HOME CONSTRUCTOR, by Marston, 130 pages. Four chapters based on US articles. Projects vary from low level amplifiers to complex test equipment. **$4.30.**

STOP PRESS

AM-FM TUNER

FM is just about to start and we've located a great little tuner. Multiplex with stereo indicator. 240V operated. Walnut case Great value

$75 only Post Free

104 EASY TRANSISTOR PROJECTS YOU CAN BUILD, R. M. Brown, 224 pages. Here are easy-to-build projects for everyone from hobbyist-experimenter to experienced hams and audiophiles. Devices range from those everyone can use around the home to more specialized hi-fi and ham radio equipment, others for fun and games, or for your car. Every circuit is safe, even for beginners. All parts are readily available, inexpensive items. In most cases, you can use "junk box" parts. **$4.05.**

NEWNES RADIO ENGINEERS POCKET BOOK, Moorshed, 188 pages. As the name suggests, this is a pocket book, but the physical size is no indication of the material inside. It is packed with valuable data including symbols, equations, physical properties formulae, colour codes, transistor circuits and characteristics, transistor outlines, semiconductor glossary, coil data, capacitors, resistors, inductors, wire data, transformer data, dielectric constants and power factors. Resistance of metals and materials, laws, charts, codes, tables and much more. An ideal quick handy reference for the workshop, hamshack, lab, hobbyist bookshelf and all involved in the electronics industry. **$3.50.**

NEW CATALOGUE OUT NOW

The latest edition of the world famous Dick Smith catalogue is available now. It must be the best catalogue around — there's so much in it. The type is half size of its nearest rival. In fact we've crammed nearly 200 pages worth of bumph into 64 pages. So get your new specs out or buy a magnifying glass!!

Dick's catalogue also beats the rest of 'em because he gives you so much useful info about all the products plus suggested circuits plus other essential information that hobbyists and professionals need — IC and Transistor specs for example.

The new catalogue has an enlarged section for Amateurs plus a huge Book section, more speakers and unusual things like heat shrink tubing and spring packs. Usual 50 cent discount vouchers, simple mail order form etc. etc.

There will only be a limited quantity of catalogues available due to paper shortage. Avoid disappointment by getting a copy now and for your friends (give us their names and addresses). Your name goes onto our special mailing list for bargains not normally advertised. Send the coupon now!!

- 64 pages crammed with illustrations, specs, diagrams etc.
- Specially orientated towards Mail Order customers
- Large information section
- Usual discount vouchers and mail order form
- Enlarged Amateur and Book sections
- A must for anyone remotely connected with electronics

Dick please send me your new catalogue. I enclose 30 cents towards post and packing.

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also at — 361 Hume Highway Bankstown (100 yds from Chapel Road). Tel 709 6600

Dick Smith Ele

BIG PRICE CRASH

All are new guaranteed National, Fairchild, STC, Texas, Motorola and other well known brands.

FAIRCHILD	PHILIPS	TEXAS
2N5088	BC549	BC184L
SE4010	BC548	BC183L
PN4250	BC559	BC213L
2N4250	BC558	BC214L
PN3643	BC549	BC184L
2N3643	BC548	BC183L
PN3638A	BC559	BC213L
2N3638A	BC558	BC214L
MPS3638A		
PN3565	BC548	BC183L
2N3565	BC549	BC184L
AY8171	BD235	TIP31B
2N4232	BD201	
AY9171	BD236	TIP32B
2N3740	BD202	

Table listing replacements for Fairchild
The new types of transistors can be used with the power modules in the Playmaster 135, 136 and 140, without any loss of performance.

TRANSISTOR BASE CONNECTIONS
With modern plastic pack transistors (T092 Case) each manufacturer appears to have their own pin configuration. As a guide we show the following diagrams, however, if you are in doubt we suggest you check the device on a transistor tester.

EBC
Fairchild & National BC547, BC548, BC549, etc.

CBE
Philips (Kinked base lead) & Texas with suffix "K" i.e. BC182K, BC183K, BC184K.

ECB
Texas with suffix "L" i.e. BC182L, BC183L, BC184L

Transistors, Brand New & Fully Guaranteed

AC107	.80	.70
AC125	.50	.45
AC126	.50	.45
AC127	.75	.65
AC128	.75	.65
AC127 / 128 Pair	1.50	1.30
AC132	.65	.60
AC187	.80	.70
AC188	.85	.75
AC187 / 188 Pair	1.60	1.50
AD149 Use OC26	1.60	1.50
AD161	1.60	1.50
AD162	3.20	3.00
AD161 /162 Pair	1.00	.90
AF114	1.00	.90
AF115	1.00	.90
AF116	1.00	.90
AF117	1.50	1.40
AF118	1.40	1.30
ASZ15 (OC28)	3.60	3.40
ASZ16 (OC29)	3.65	3.45
ASZ17 (OC35)	3.60	3.40
ASZ18 (OC36)	3.65	3.45

AY8171 USE TIP31B		
AY9173 USE TIP32B		
AY8149 USE 2N3055		
AY9149 USE MJ2955		
BC107 (BC547)(BC182)	.25	.22
BC108 (BC548)(BC183)	.25	.22
BC109 (BC549)(BC184)	.25	.22
BC109C (BC549C)	.45	.40
BC157 (BC177)(BC212)	.30	.26
BC158 (BC178)(BC213)	.30	.26
BC159 (BC179)(BC214)	.30	.28
BC186	.70	.65
BCY70	.80	.70
BCY71	.95	.85
BCY72	.70	.65
BD137	1.00	.95
BD138	1.00	.95
BD137/138 Pair	2.00	1.90
BD139	.90	.85
BD140	.90	.85
BD139/140	1.70	1.60
BDY20 Use 2N3055		
BF115	.80	.75

BF167	1.00	.90
BF173	1.00	.90
BF177 (BF336)	1.50	1.40
BF178 (BF336)	1.50	1.40
BF179 (BF337)	1.60	1.50
BF180	1.20	1.10
BF184	.85	.75
BF185	.85	.75
BF194	.50	.45
BF195	.50	.45
BF200	1.25	1.20
BFW10 Use 2N5459		
BFW11	1.45	1.35
BFW61	1.30	1.20
BFY50 (2N3053)	.80	.70
BFY51	.80	.70
BFY52	.80	.70
D13T1 (2N6027)	1.40	1.30
MJ2955	3.20	3.00
MPF102	.95	.90
MPF103(2N5457)	1.20	1.10
MPF104(2N5458)	1.10	1.00
MPF105(2N5459)	.95	.90
MPF106 (2N5485)	.95	.90

MPF121	.95	.95
OC26 (AD149)	1.60	1.40
OC28 Use ASZ15		
OC44	.50	.45
OC45	.50	.45
OC70	.45	.40
OC71	.40	.36
OC72	.50	.45
OC74	.50	.45
OC75	.50	.45
OCP71 (Photo)	1.80	1.70
TIP31A (USE TIP31B)		
TIP32A (USE TIP32B)		
TIP31B	.95	.90
TIP32B	1.00	.95
TIP2955 (MJE2955)	1.30	1.20
TIP3055 (MJE3055)	1.20	1.10
TT797	1.20	1.10
TT798	1.20	1.10
TT800	1.00	.95
TT801	1.00	.95
2N301	2.80	2.60
2N706A	.90	.80
2N2646	1.40	1.30

2N2926	.60	.50
2N3053	.80	.70
2N3054	1.70	1.60
2N3055	1.20	1.10
2N3563	.75	.65
2N3564	.55	.50
2N3565 (USE BC108)		
2N3566	.65	.60
2N3567	.65	.60
2N3568	.75	.70
2N3569	.65	.60
2N3638 (MPS3638)	.45	.40
2N3638A (MPS3638A)	.55	.50
2N3640	.60	.50
2N3641	.45	.40
2N3642	.45	.42
2N3643	.55	.50
2N3644	.45	.40
2N3645	.55	.50
2N3702	.60	.50
2N4250	.80	.70
2N4258	.60	.55
2N4292	.70	.60
2N5484	2.75	2.50
40250 Use 2N3054		
40408	2.50	2.40
40409	3.00	2.90
40410	3.00	2.90

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SN7400N	$0.60	$0.54	$0.48
SN7401N	.60	.54	.48
SN7402N	.60	.54	.48
SN7403N	.60	.54	.48
SN7404N	.60	.54	.48
SN7405N	.60	.54	.48
SN7408N	.60	.54	.48
SN7409N	.60	.54	.48
SN7410N	.60	.54	.48
SN7413N	.80	.72	.65
SN7420N	.60	.54	.48
SN7430N	.60	.54	.48
SN7437N	1.20	1.10	1.00
SN7440N	.60	.54	.48
SN7441AN	2.20	2.10	2.00
SN7442N	2.00	1.90	1.80
SN7447N	3.00	2.80	2.60
SN7450N	.60	.54	.48
SN7451N	.60	.54	.48
SN7453N	.60	.54	.48
SN7454N	.60	.54	.48
SN7460N	.60	.54	.48
SN7470N	1.00	.95	.90
SN7472N	1.00	.95	.90
SN7473N	1.20	1.10	1.00
SN7474N	1.20	1.10	1.00
SN7475N	1.50	1.40	1.30
SN7476N	1.20	1.10	1.00
SN7480N	1.80	1.75	1.70
SN7482N	1.90	1.85	1.80
SN7483N	2.45	2.40	2.35
SN7486N	1.20	1.10	1.00
SN7490N	1.25	1.20	1.15
SN7491AN	1.60	1.55	1.50
SN7492N	1.50	1.45	1.40
SN7493N	1.50	1.45	1.40
SN7495N	2.20	2.10	2.00
SN7496N	2.20	2.10	2.00
SN74107N	1.10	1.00	.90
SN74121N	1.20	1.10	1.00
SN74141N	3.20	3.10	3.00
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SN74193N	4.00	3.80	3.70

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Heat sink clamp suit BYX21L		.50	.45

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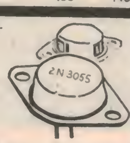

Each pair consists of 1 x 2N3055 or 1 x MJ2955 – Yes genuine 115 watt TO3 metal packages – Don't buy Lower wattage plastics.

Only $4.00 pair

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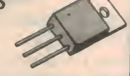

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14 pin	.45	.40
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BA114	.40	.35	.30
OA90	.25	.20	.15
OA91	.25	.20	.15
OA95	.25	.20	.15
OA200	.30	.25	.20
OA202	.30	.25	.20
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Coded GP100 brand new TO3 metal case germanium P.N.P. Possible replace OC25, OC28, OC29, OC30, OC35, OC36, ASZ15, ASZ16, ASZ17, ASZ18 and majority of germanium power transistors in OC, AD and NKT range.
Vceo – 50V Vcbo – 80V I.C. – 10 amps
Ptot – 30W hfe – 30-170

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Plessey SL414A (Replaces SL403D)	$6.50
Texas SN76023	2.50
Philips TAA300	2.90
SGS T8A640 (3.5 Watts at 12 volts)	3.50

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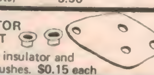

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ND120 NIXIE DRIVER TRANSISTOR

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1-9 ONLY 75c *10up* .65

SILICON RECTIFIERS – Fabulous Value

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EM4005 / IN4001 50 Volt	.15	.14	.13
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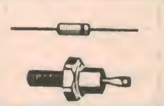
EM410 / IN4007 1000 Volt	.36	.34	.30
10 Amp (Stud SO10 Case) – A Bargain			
MR110 100 P.I.V.	.90	.85	.80
MR410 400 P.I.V.	1.20	1.10	1.00



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Electrically equivalent to 2N2646 etc.

60 CENTS 10 up 50c

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–Ideal for S.C.R. ignition etc. – TO48 Case.

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C164D 400 Volts at 16 Amps	3.00	2.75
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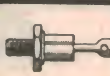

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Lge with Mtg, red	.40	35
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115 Watt Silicon NPN Power – FULLY IMPORTED – best in Australia . and cheapest too!
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10 transistor radio IC from Ferranti. Operates from 1.5V. Power Gain 72 db consumes only 300uA. Frequency range from 150kHz to 3MHz. See Elementary Electronics E.A. May '74. **ONLY $3.95**

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7805 1 amp at 5 volt
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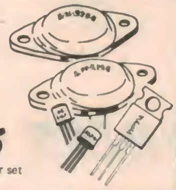

LINEAR INTEGRATED CIRCUITS

TYPE	CASE	DESCRIPTION	1-9	10 up
AWM 1306	TO5	FM Converter	$6.20	$5.80
CA 3028A	TO5	RCA Linear	3.00	2.80
LM 301A (UA 301A)	D.I.L.	High input operational amp.	1.30	1.20
LM 308 N	DIL	Operational amp.	4.00	3.60
LM380N	D.I.L.	Audio IC	2.75	2.50
LM 381	D.I.L.	Dual operational amp	4.50	4.00
LM 709 (see UA709C)				
LM 741 (see UA741C)				
MC 1330P	D.I.L.	Homodyne IC	3.20	3.00
MC 1469R		½ amp voltage regulator	4.75	4.40
NE 555	D.I.L.	Timer IC	2.45	2.20
NE 556	D.I.L.	Dual timer	1.50	1.50
NE 561B	D.I.L.	Phase Lock Loop IC	11.75	11.00
TAA 300	TO5	1 watt audio amp	2.90	2.70
TAA 521 Equiv. 709C				
TAA 840	D.I.L.	AM Radio tuner	3.20	3.00
TBA 221 Equiv. 741C				
TBA 281 Equiv. 723C				
UA 709C (LM709)	TO5 or D.I.L.	General Purpose amp.	1.00	.95
UA 723C (LM723)	TO5	Regulator	1.50	1.40
UA 739C	D.I.L.	Dual OP amp. low noise	2.50	2.25
UA 741C	TO5 or D.I.L.	Operational amp.	1.20	1.10
OM 802		Timer I.C.	2.50	2.30

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MB10	1.8A	1000	4.20	4.00
PA40	8A	400	6.00	5.75
PA60	8A	600	6.75	6.50
PB40	25A	400	7.20	7.00

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FND70	0.3" high	3.40	3.20

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2N5591	30 Watt	9.85	9.35

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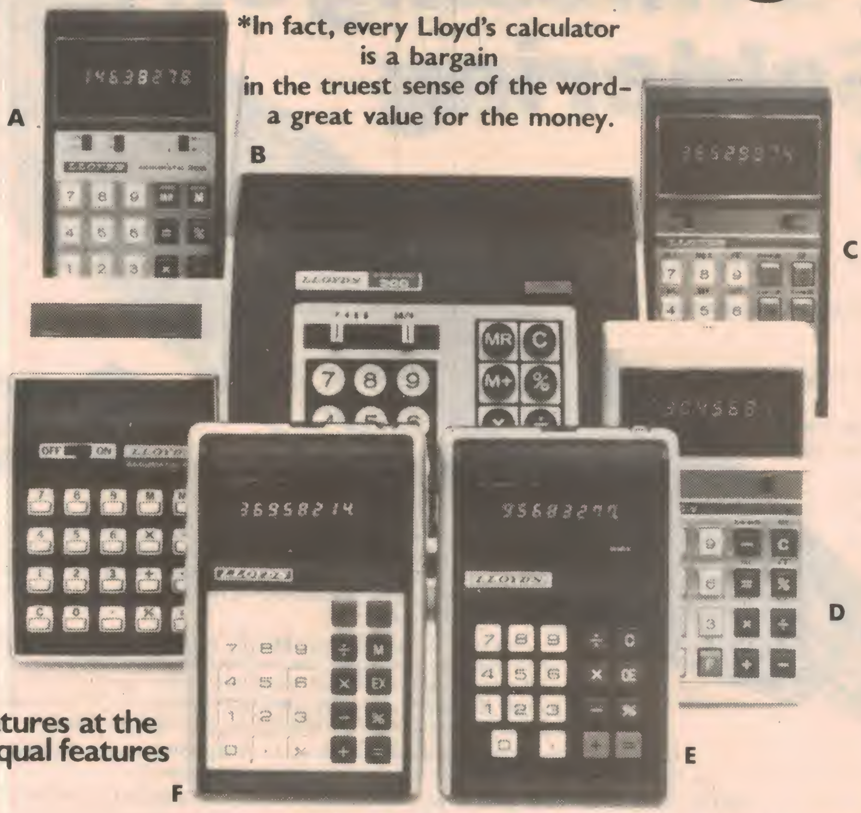

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- High-powered pocket model
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(D) Model EH-9143
- Scientific pocket model
- High-intensity 8-digit display
- Performs: square roots, powers of numbers, reciprocals, and more.
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- Percentage key
- Floating or fixed (to 2 places) decimal
- Negative and overflow indicators
- Automatic constant
- 3-way power from penlite batteries, rechargeable batteries, or AC adapter/recharger (supplied with unit)

(E) Model EH-9036
- Economical pocket model
- Bright 8-digit display
- Percentage key
- Floating decimal
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- Automatic constant plus chain and mixed calculations
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(F) Model EH-9325
- Efficient pocket model
- Large 8-digit display
- Square root key; Percentage key
- Fully addressable memory bank
- Negative and overflow indicators
- Floating decimal
- Direct reciprocals and squaring of numbers
- Automatic constant
- Operates on 4 penlite batteries or optional AC adapter

(G) Model EH-8053
- Prism-aided 8-digit liquid crystal display
- Compact design and light weight
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- Percentage key
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The Serviceman

An unusual service job

With the ever increasing cost of labour, it is becoming less of a proposition for the average serviceman to tackle electronic devices outside his particular field. As a result, stories about unusual devices and their service problems are occurring less frequently. This month's story is one of the exceptions.

It was submitted to me by a colleague who works in the laboratory of a large electronics organisation. While his servicing activities normally do not extend beyond his own domestic appliances, plus the occasional "love" job for a relative, he recently found himself involved in a most unusual servicing exercise.

Although not the kind of job a professional serviceman would be likely — or could afford — to become involved in, it is nevertheless a most interesting story from a technical point of view. Here is his account of what happened.

A few weeks ago I was talking to the sales manager of a large time equipment organisation. Although I have a wide general interest in things electronic, I have a particular interest in time-keeping and clocks. It matters not whether the clock is mechanical, with a pendulum or balance wheel, or whether it is of the more recently developed crystal controlled clock. Inevitably, the conversation got around to clocks, and crystal clocks in particular.

It was not long before my friend mentioned that his firm had been given a crystal clock to repair but, although they dealt with electronic clocks, this one was a foreigner and the repair men were somewhat reluctant to tackle what seemed to them an unknown quantity. Would I like to see it? It so happened that this particular make of clock had intrigued me for the past six years or so, since I first saw one in a department store. I had wanted to know just how they achieved certain functions, so I grasped his offer with both hands.

A day or two later, the clock was brought to me with the explanation that it had been involved in a mishap at sea and dunked in the ocean. I was at liberty to investigate it as much as I wished and when I suggested that I might try to get it going just for the privilege of having a good stickybeak, my friend was most enthusiastic; any efforts along these lines had his blessing. He also suggested that I might like to talk to the owner direct and gave me his name nad telephone number.

A chat with the owner was interesting to say the least. He is a keen yachtsman and while sailing off the south coast of Queensland during the summer of 1972, he was caught up in one of the thirteen cyclones which ravaged the Queensland coast that season. During the particular night, they ran aground about 1km from shore just near the entrance to Moreton Bay. The yacht was then abandoned, but next day much of the equipment was salvaged, and this included the clock.

The clock was washed out with fresh water after it had been in salt water for about 48 hours. After this, it was taken, along with other instruments salvaged, to a retired instrument maker who is a friend of the owner. The instrument maker salvaged all the other instruments, including two wrist watches, but the clock was obviously the worse for its experience and it was decided to send to Germany for a new mechanical movement. This was received in due course and fitted by the instrument maker. However, he was disappointed; there was obviously more to making the clock go again than replacing the movement. Not being au fait with electronics, he sadly conceded defeat. This seems to be where I came in!

As well as the clock itself, I had been given some descriptive brochures, and a small manual which came with the clock. Apparently, these had not finished up in the sea. From the information they contained I was able to get a good picture of the basic design; crystal frequency, order of frequency division, rate of the mechanical movement etc.

The electronic clock as it was returned to the owner. Housed in a sturdy aluminium alloy case, it had suffered very little visible damage from its ordeal. It was a different story with the movement and the electronic components.

Basically, it consisted of a crystal oscillator operating at 12,800Hz, ten flip-flops (two to one dividers), and a mechanical movement running at 12.5 beats per second. The whole thing operated from a single 950 dry cell.

An initial look at the clock, both outside and inside, gave me the impression that it had come through the ordeal surprisingly well. To be sure, there were minor signs of corrosion but I felt that it could have been a lot worse. A new 950 dry cell had been fitted but there was no sign of life at all.

The physical layout appeared to be very good with easy access to most of the device. The mechanical movement, in a perspex case, was about the centre of things. At other strategic points were the battery clamp, a glass enclosed, vacuum sealed crystal and a neat row of eleven small plug-in printed boards. The first board accommodated a major portion of the crystal oscillator and the other ten were the flip-flops.

Where to start? The crystal oscillator of course! I switched on the CRO and applied the leads to the oscillator. It was not functioning. I picked a flip-flop board at random and pulled it out from its six contact socket. It was an easy matter to trace the circuit, which proved to be quite standard. I set this board up on the bench and fed some audio into the input, with the CRO across the output. Again, nothing. The two polystyrene capacitors looked very suspicious so I removed both of them and checked for leakage. There was plenty of this. I replaced both, switched on again, and away it went.

Encouraged by this, I treated another board in the same manner and I was rewarded the second time. This seemed to suggest that all capacitors should be replaced. It was just possible that most, if not all, transistors, resistors and diodes would be OK. It also suggested that the crystal oscillator might be made work simply by replacing its four capacitors.

The oscillator board was also a plug in device and it was no time before I had replaced the capacitors with new ones. Unfortunately, some substitution had to be resorted to as the precise type was in short supply. The new ones presented some slight physical problems but nothing serious. Hopefully, the new capacitors would not upset the crystal frequency too much, nor introduce unwanted temperature effects which could spoil its time keeping.

I plugged in the board and looked for output on the CRO. To my delight, all appeared to be functioning as it should. Just for good measure, I applied a frequency counter and it indicated 12,800Hz, exactly as specified.

Up to this point, I must confess that the whole operation was exploratory but now it seemed reasonable to suppose that it would be possible to get the whole instrument functioning again and, hopefully, as good as new. I plugged in the first divider board and looked for output at 6400Hz. Sure enough, there it was. I plugged in the second divider and success again. Number three was not so co-operative. A simple means of isolating trouble on these boards seemed to be with an ohm meter. One could check resistance

between various points, across resistors and both ways across diodes and transistors. These readings could be checked against a known good board.

This showed up one transistor in a bad light and replacing it brought that board to life. By going through the boards in a systematic manner I was able to get them all back into operation Apart from the capacitors which had already been replaced, it required three transistors, one silicon diode and one 1M resistor.

Having fitted nine of the dividers and checked that all was well, it then seemed that the last board would be plugged in and only a few simple steps would be needed to put the system into operation. I plugged in the board and, to my satisfaction and surprise, the movement started ticking. Success indeed. Normally, battery operated, transistor switched clocks have a starting device of one type or another, such that the balance wheel is given a kick to start it on its way. These clocks usually have a balance wheel which operates at five beats per second and is a somewhat sluggish device. This balance wheel, at 12.5 per second, is a much more lively affair.

Nevertheless, the success so far had to be qualified. How long would the clock run before it developed another hidden fault? And even if no further faults developed, had I upset its timekeeping qualities beyond the adjustment available. All I could do was wait and see.

After running for about 12 hours, it stopped. A quick check with the CRO soon isolated the offending divider and a close look with a watchmaker's eyeglass revealed a suspicious looking joint. Resoldering this brought results again. This time, the clock ran for about a week and, during this time, I was able to determine that it had a losing rate of about 250ms per day. The owner was happy to leave it at that but I felt that as this was well within the adjustment range of the oscillator trimmer, I would like to attempt to get it much closer.

More about the adjustment in a moment. Meanwhile, the clock stopped again and by this time I was becoming quite agile at locating and repairing either dry joints, or a faulty diode or resistor. So far, all this work had been carried out at my place of work, during spare time, and where all necessary facilities were readily available. However, I wished to take the whole unit apart and check less accessible places for possible faults, and to trace out the rest of the circuit which interested me more than somewhat. To do this, it would be necessary to spend a lot of time under uninterrupted conditions. The answer was to take it home for a week-end.

On the Friday evening when I took the clock home, it was running very well, still with the predictable losing rate. After the evening meal, I settled down on the kitchen table and proceeded to take the little monster apart. The circuit was duly traced and all points inspected for possible trouble and all seemed to be well. At this point I attempted to adjust the trimmer but it was stuck fast and no persuasion with solvents etc. would move it. As it was only possible to replace the trimmer with the unit pulled down, I decided to do so and very luckily, I happened to have a miniature trimmer with an Invar screw — ideal for the job.

The new trimmer was fitted and the whole

unit reassembled and set going again. Needless to say, the trimmer was set by guesswork and it turned out that the clock was losing about 1.5 seconds per day. A couple of turns of the trimmer brought the rate to about 250ms per day and at this point, it seemed reasonable to make another adjustment to bring it quite close. After this it might take days or weeks to establish whether further adjustment would be worthwhile.

Having made the adjustment to correct the 250ms losing rate, I stopped the movement in order to test it precisely to time against VNG. And, from here on, it was one frustration after another. In fact, the chain of events working against proper operation borders on the fantastic and I can scarcely believe it myself. As you may have assumed, the clock refused to go.

The usual check with the CRO showed that all circuits were working and that a signal was being fed to the movement but it refused to go. Finally, it occurred to me to check the frequency at the output. Sure enough, it was 25Hz instead of 12.5Hz. The offending circuit was traced to the second divider which was not dividing. Another dry joint repaired and the unit should then have worked, but not so. By now, another divider had refused to function. It was made operative and then another board dropped out. Fantastic indeed — and very frustrating.

Finally, all was well again and the unit was functioning. I breathed a sigh of relief. By now it was Sunday night and I had promised the owner that he could have his clock back on Monday, so that he could use it for navigation on a short trip he was planning. All I had to do now was to take it into work with me and the owner would pick it up from there.

By Monday morning — yes, you guessed it — the clock had stopped. It was another dry joint, which I fixed that evening. On Tuesday morning it had stopped again. The fault was quickly traced to divider board No 2 again, so I grabbed it before leaving for work. During my lunch hour I removed each resistor, diode and transistor in turn, carefully cleaned all the leads, and soldered each back on the board.

This started it running again but the havoc which salt water can do to a piece of electronic equipment has to be seen to be believed, even after a relatively short immersion and a reasonable wash in fresh water afterwards. A close inspection with a watchmaker's glass revealed that soldered joints which would be quite satisfactory in a normal environment can easily fail when so abused. It appears that tiny openings and pockets admit and retain salt water in spite of subsequent washings. Eventually this creates trouble.

To make a thorough job of repairing such an instrument it must be assumed, first, that all components are good and likely to stay that way. Then, it would seem to be necessary to remove each component, clean and tin each lead, and resolder it to the board. And, if one has doubts about the reliability of the original components, it may be wise to replace these also. In short, almost a complete rebuild.

But to get back to the unit itself. It ran for a few more days after this, then began giving trouble again. I traced this to the No 4 divider and made several attempts to fix it. While each attempt seemed to be successful, each was short lived. Finally, I decided that this board was so bad as to warrant the full treatment; a complete rebuild with all new components. As far as that particular board was concerned, this appeared to be completely successful.

The clock ran for some time after that, until we encountered a bout of very humid weather. When it failed I had no difficulty in tracking it down to a particular board, but I could find nothing specific wrong with the board. Intuitively, I suspected the humid conditions, particularly with the history of immersion. On this basis I gave the entire board a good scrub with a suitable cleaning fluid, replaced it, and hey presto — away it went. Subsequently I gave another board the same treatment when it misbehaved, with equal success.

Although I did not know it at the time, this was to be the last failure up until the time of writing. As the days went by and the clock continued to tick merrily away I began to concentrate more and more on adjustment for maximum accuracy. After all, this was the ultimate purpose of the exercise.

faultlessly and did not drift enough to justify further adjustment. At the end of that time I felt it was worthwhile passing it back to the owner. After all, he could keep an eye on its behaviour, and check its rate, just as well as I could, now that most of the problems seemed to have been solved.

That was several weeks ago and, at last report, it was still ticking and keeping excellent time. He has promised to keep in touch with me and report any failures immediately. Hopefully there will be none.

Having seen the exercise through to a successful conclusion, one faces the inevitable question; is it worth while? This is not a simple one to answer. Much depends upon the actual value of the equipment, compared with the cost for labour and materials to rebuild it. With domestic equipment, such as TV sets, tape recorders, radiograms, etc, it would not be a proposition. With expensive instruments however, it may well be worth while. In this case, it would be reasonable to say that this clock could not be replaced for much less than $500. Costs of labour and materials amounting to, say, $150 may well be a proposition.

Interior of the clock. At the left are the 10 divider boards and the crystal oscillator board (lowest). The new trimmer is beside the boards and the crystal is below the movement.

As a matter of interest, the owner had quoted some figures from his own observation. Except when he was actually sailing he kept the clock in his lounge room, which was air conditioned, and, in this almost ideal environment, he claimed an error of only a few seconds a year. Even when the clock was on his yacht, without the benefit of temperature control, he claimed that it was better than one second a month.

As already mentioned, I had made some rough adjustments after fitting the new trimmer, the last recorded error being about 250ms a day. I had attempted to correct this but, before I could observe the effect, the series of failures set in in rapid succession. It was only now, with it seemingly running reliably, that I could begin to check the effectiveness of that last adjustment.

I was happy to observe that it seemed to have been very close because, for several days, I could not observe any error at all. Then I began to sense that it was gaining, but it was nearly a fortnight before I could put any value on it. By that time I estimated that it had gained about 200ms — and I adjusted the trimmer accordingly. How much? About one eighth of a turn, on a trimmer with a total range of only 5pF for 5 turns.

That was the last time I touched it. I kept it under observation for another couple of weeks, during which time it behaved

In this particular instance, of course, there was another side to the story. I had a personal interest in the clock, and was quite happy to devote a good many hours to simply finding out as much about it as I could. The fact that I happened to get the clock going in the process was almost incidental. Granted, the going was rough in spots, but it gave me a lot of personal satisfaction to be able to meet the challenge. And I have learned a lot about clocks.

But the moral is plain. Don't dunk electronic equipment in the sea. If you do, it may be easier to throw it away and start again. It is not every day that you will find someone who is prepared to salvage it for the privilege of finding out how it works.

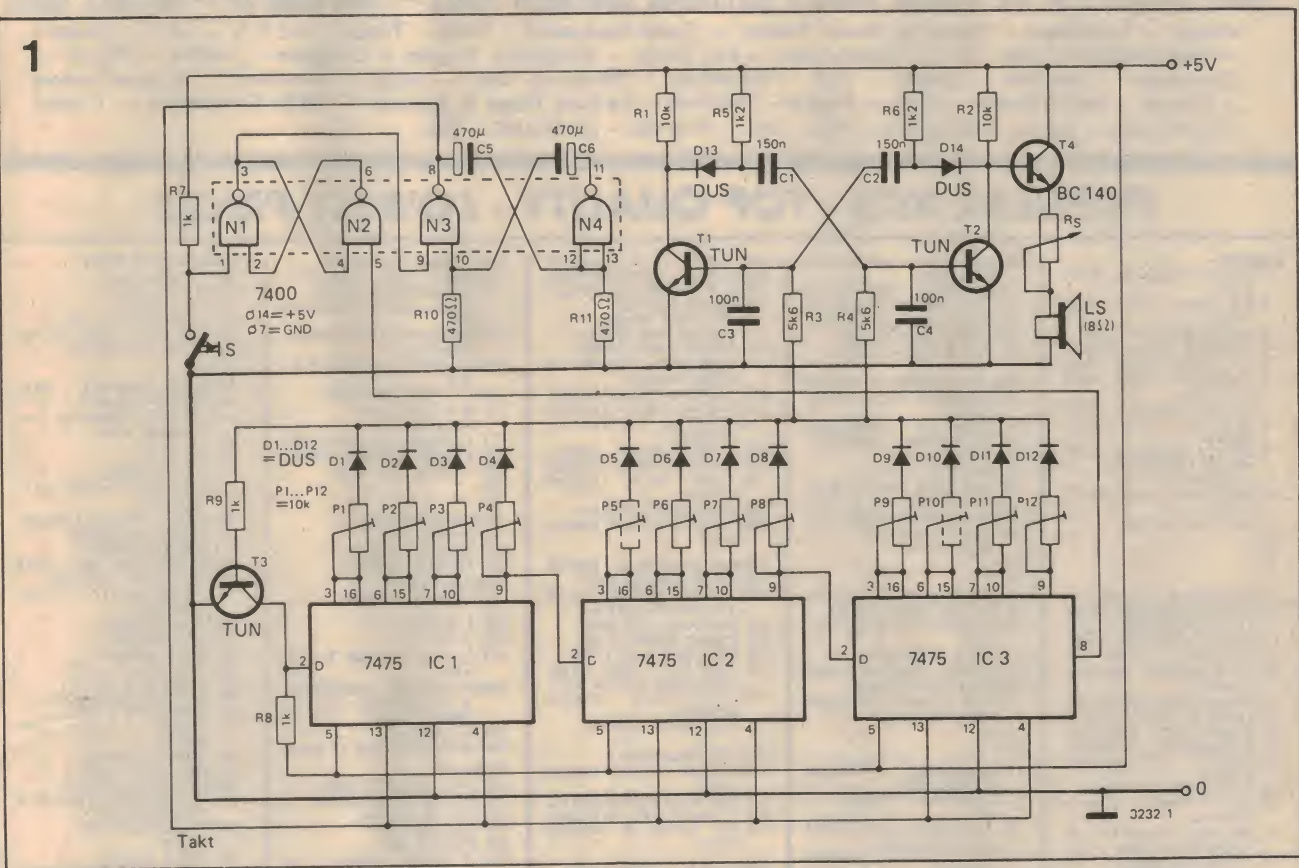
(Editorial note:) Publication of this story has been delayed for several months, due to the need to present more topical material. As a result it is, at the time of writing, over five months since the owner took delivery. A recent check by the author established that the clock was still going, with a gaining rate of about one second per month; about the same order of accuracy it achieved when new. For the moment at least, the owner is content to live with this error, rather than risk fiddling with the adjustment.

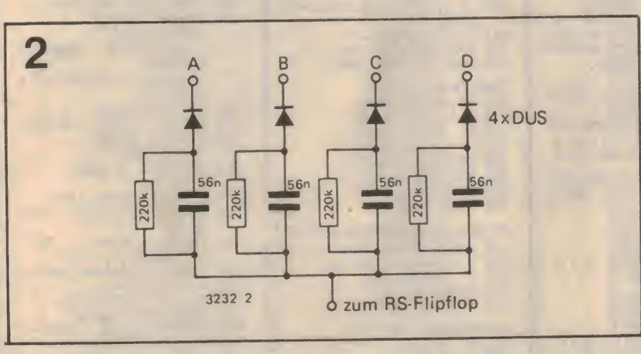
Circuit & Design Ideas

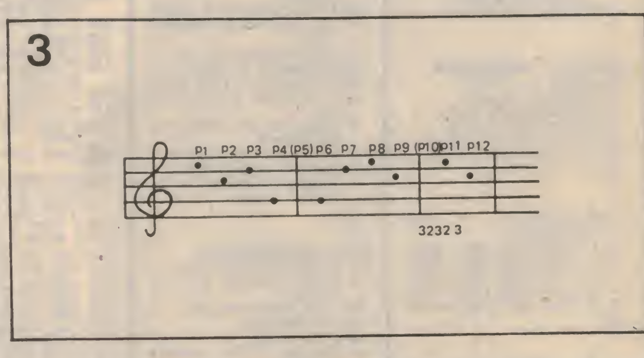
Conducted by Ian Pogson

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Your contributions are welcome, and will be paid for if used.

Electronic "Big Ben" chimes







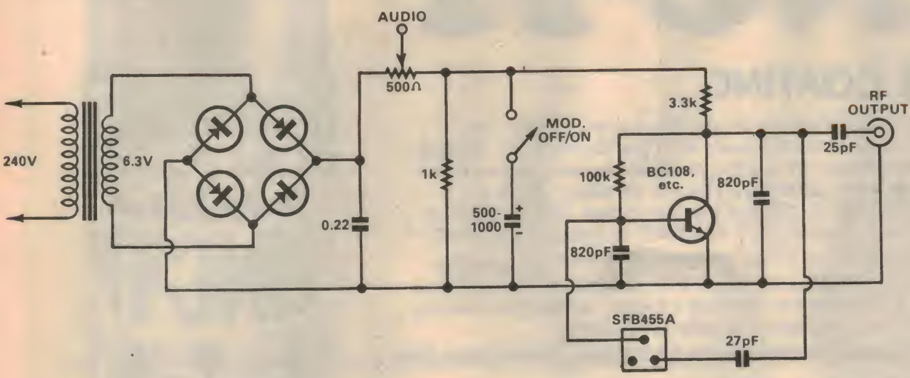
Here is an item from a German magazine which I thought would interest a number of readers. There is sufficient information on the circuit diagram for more advanced technical readers to duplicate the device. My knowledge of the German language is rather wanting but fortunately a friend translated part of the text and it goes something like this:

The electronic Big Ben can be used as a door-bell, or in connection with a digital clock. Each of the 12 notes can be adjusted as required, or left out. As a result, in addition to the Big Ben chimes, it is possible to set up other simple melodies.

The circuit may be triggered on the hour from a digital clock, by means of the circuit of figure 2. The A-D contacts are connected to the BCD decoder of the clock and the outlet to pin 3 of the 7400 IC. Big Ben will start when a negative-going pulse appears at the outlet of the switching circuit.

(From "Elektor".)

Modified 455kHz Minispot



When one sets out to build a piece of equipment, all too often the old junk box does not deliver the exact components required and so it becomes expedient to alter the circuit to suit the components available. This was the case when I decided to build the Minispot recently. The multivibrator audio source was replaced with a 240V to 6.3V heater transformer. The secondary winding of the transformer feeds a bridge rectifier with very little filtering. The resultant output of effectively a DC component modulated with 100Hz may be used to replace the functions of the original multivibrator and the 9V DC supply from a battery.

When an unmodulated signal is required, the 100Hz ripple may be filtered out by switching in an electrolytic capacitor of 500 to 100uF. The four diodes which I used in the bridge rectifier circuit were taken from old computer boards.

(By Mr J. C. Stacey, "Cooinda", Merriwa, NSW 2329.)

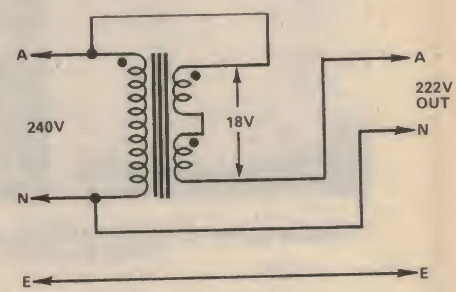
Economical mains step-down transformer

A certain proportion of imported electronic equipment is designed to work on a maximum mains input voltage of 220V, rather than the 240V common in most parts of this country. While such equipment will often work satisfactorily on 240V, this can result in excessive temperature rise and shortened life. If a means can be found to reduce the effective mains voltage at low cost, this can therefore be desirable.

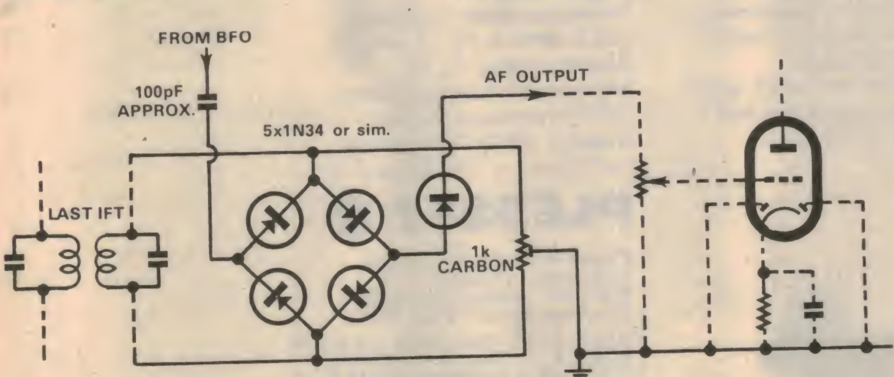
Commercial stepdown transformers are available, in both double-wound and autotransformer versions, but these are not cheap. As it happens, there is a much cheaper alternative, shown in the diagram. A small stepdown transformer with a total secondary voltage of around 18-20V is all that is needed; the secondary is simply connected in antiphase series with the active line, so that it effectively subtracts from the 240V input.

With a transformer rated at 20VA, this setup will be able to cope with a 220V load of up to about 240 watts — more than enough for most applications. Note that the transformer should be rated to withstand a high voltage on the secondary, but this would be no problem with locally made types meeting the C126 safety specification. In any case it would be desirable to either earth the transformer frame, or mount it in a suitably insulated box.

(By Jamieson Rowe, Electronics Australia)



Ring mixer detector for up-dating old receivers



Roger C. Arnold presents an idea for a simple-to-add SSB/AM detector for updating mechanically sound but old receivers. He recently converted a BC1147A in this way and feels that the conversion works so well that the idea may be of interest to others.

He writes: "This ring mixer can be used with virtually any of the old valved communications receivers. Its main feature is that it requires no switching for the AM to SSB mode and has very simple circuitry which can readily be built into the final IF transformer can. The only switching that is necessary is to switch on the BFO in the normal CW mode, so one does not even have to modify the front panel to include any new controls.

"It should be noted however, that the detector can be overloaded by very strong signals and put out of balance, but if the RF gain is backed off a bit, normal SSB reception will be recovered."

It is not certain just what effect the diode in the AF output may have since this would possibly have a "threshold" effect on the zero crossings, but presumably Roger Arnold has not found this a problem in practice.

(From "Radio Communication".)

What's new in Solid State

Start of a timely new feature

No, you haven't seen the above heading in the magazine before, this is its first appearance. But we hope to be able to make it at least a semi-regular column from now on. There is a great deal of interesting information on solid state devices and techniques being put out by manufacturers nowadays, and a column like this will enable us to help readers keep in touch with developments.

Our main problem will be to present all of the material of potential interest before it becomes dated, without letting the column grow to the point where it could engulf the whole magazine!

In order to cope with this problem, it will be necessary to give only brief details of most of the devices and techniques discussed. But in doing so we will strive to pick out the "nitty gritty" or heart of the information, so that readers will hopefully find the column of real value and not just a bewildering product inventory.

To begin, then. If you still think that LSI (large-scale integration) techniques are only being used to produce very way-out devices of no interest to the hobbyist or amateur, you may be interested in a new device released by the UK microelectronics arm of the General Instrument corporation. Called the AY-5-4007, it is designated a "four digit counter display driver".

As the block diagram shows, the AY-5-4007 is a complete LSI subsystem which can form the heart of digital counters and frequency meters, voltmeters, timers or any similar instrument using counting and display. It contains a four decade BI-DIRECTIONAL counter, a four decade storage register which can serve as a latch for the counter, an output BCD multiplexer with its own built-in oscillator, and both BCD and 7-segment outputs in addition to the digit select outputs.

As if this were not enough, the device is also provided with a serial output from the storage register, and a shift clock input so that if desired the 16-bit contents of the register may be shifted around and fed out serially, without being lost. The digit select outputs may also be changed from active high to active low convention for interfacing flexibility, by means of a control signal input. And the internal multiplexer clock may be overridden by an external clock, if desired.

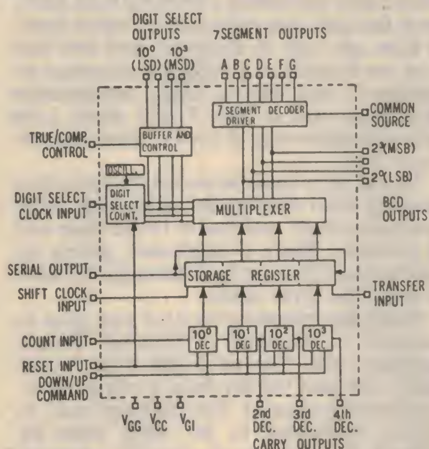
The AY-5-4007 operates from a positive 5V substrate voltage and a minus 12V gate supply. The 7-segment output transistor are 40-ohm low impedance types, capable of passing 25mA for driving LEDs, fluorescent displays or incandescent readouts.

Operating frequency range for the count input of the device is DC to 400kHz typical, with a range of DC to 500kHz for the shift register clock.

In short, a very flexible device, and one which should make it very easy to build low frequency counters in particular. The price is around $25 in small quantities, which is not bad considering the job it does.

While we are talking about LSI devices in general and GIM devices in particular, a more specialised device which they have released recently is the AY-5-1012. This is a "UART", short for "universal asynchronous receiver-transmitter".

If you've not come across such an animal before, it is basically an interface unit designed to transfer 8-bit digital data between a parallel system (such as a mini-or microcomputer) and a serial teleprinter circuit. It handles transfer in both directions, hence the description.



In the "transmit" or parallel-to-serial direction, it takes 8-bit parallel words and assembles them with standard start and stop bits, then shifts them out at an appropriate teleprinter rate. For "receive", it performs the opposite of this. And it can do both these operations at the same time.

Somewhat more familiar in application at least is another new GIM chip, the AY-5-1224. This is a digital clock IC, containing all the logic necessary to make a 4-digit clock for either 12 or 24 hour operation, operating from either 50 or 60Hz.

Perhaps the most interesting aspect of this new clock chip is that it comes in a 16-pin DIL package. This is achieved by using a unique "mixed multiplex" technique, wherein the 7-segment output pins are also made to serve as control signal inputs. The multiplexer has a 5-phase cycle, four being used for the four output digits and the fifth for control input sensing.

A strobe output signal is provided by the device, so that external gating is not needed to prevent control circuitry from upsetting the outputs. In fact to build up a complete 12 hour 50Hz clock with a 4 digit common cathode LED display you need only 11 resistors, 4 transistors and three push-buttons, apart from a simple power supply to provide -15V.

Local agent for GIM devices is General Electronic Services of 99 Alexander Street, Crows Nest NSW 2065.

Turning now to less elaborate devices, there are two recent ICs from Signetics which are now available locally. One is the NE557V, described by Signetics as a "long period astable multivibrator", and apparently designed in the first instance as a timing device for automatic aerosol dispensers.

Consisting of a constant current source, an SCR triggering circuit and a high current output driver, the NE557V can be connected as a long-period relaxation oscillator. It will run from two 1.5V cells, drawing less than 20uA typically during its "off" period. With timing component values of 200uF and 6.8M it gives a 15 minute off time and a 500ms on time. The output circuit will sink as much as 1.2A for short duty cycles.

The second new Signetics device is the NE543, designated as a servo amplifier. This has not only a bridge-type DC amplifier stage capable of driving a small DC servo motor, but also an internal pulse-width modulator driven from a shaft position pot, together with an error detector which compares the feedback pulses with input command pulses.

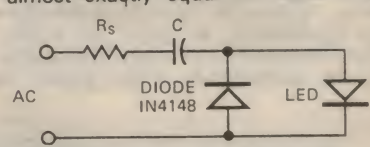
With a small handful of external parts the NE543 thus forms a complete servo system which will control the shaft position of the motor over a 100-degree range for input pulse widths varying over the range 1-2ms, with a dead band of only 4-5 microseconds. Intended pulse repetition rate is 60Hz.

The NE543 comes in a 10-pin TO-5 round can, and its small size should make it attractive for compact applications. It might be of particular interest to modellers for radio control systems using pulse-width modulation.

Local agent for Signetics is Tecnico Electronics, of 53 Carrington Road, Marrickville, NSW 2204.

The final item this month is a tip on operating LEDs from the 240V mains. I have extracted it from an application note published by the US firm Litronix. The basic idea, as shown in the diagram, is to use a series capacitor C as a voltage dropping element. The capacitor dissipates virtually no power, which is certainly not the case with a conventional dropping resistor.

A 1N4148 silicon diode or similar across the LED provides the rectification required. As the voltage drop across the LED and diode is negligible compared with the supply, in both directions, capacitor current is almost exactly equal to mains voltage



divided by capacitive reactance Xc.

Taking into account the fact that the LED only operates on alternate half cycles, the average LED current in milliamps when operating from 240V at 50Hz is given by multiplying the value of C in uF by 34. From this you can find the value of C required to produce a certain average LED current. Thus 0.47uF will give about 16mA, etc.

Resistor Rs is to limit turn-on transients. A value of 270ohms should be adequate. (J.R.)

For further data on devices mentioned above, write on company letterhead to the agents quoted. But devices should be obtained or ordered through your usual parts stockist.

Heat pipes — an exploding new technology

Despite the fact that they were invented over 30 years ago, heat pipes, until recent years, have found little application. However, the recent energy crisis in the United States has awakened the industrial and electronics industries to the heat-pipe's potential; a potential which could conceivably create a whole new technology in industry and in space research and at the same time provide environmental benefits.

by EDWARD EDELSON

"When we put one end of it to something hot, I make sure people don't touch the other end. It gets hot so fast that you can burn yourself before you know it."

The speaker was Walter W. Long of the University of New Mexico's Technology Application Center, which is currently devoting a great deal of research time on heat-pipe technology. In simple terms, the heat-pipe is a simple yet spectacularly efficient heat exchanger that requires no external power and has no moving parts.

You could probably think of dozens of uses for an invention with such ideal properties. So did a handful of engineers and businessmen, who have been boosting the heat pipe's prospects for years. But it took the present energy crunch to really bring the heat pipe's potential to notice.

Suddenly, plant engineers who exhaust waste heat are finding it practical to recover and recycle the energy. Homeowners are buying a heat-pipe device that warms rooms with energy recovered from their oil-furnace stack. Air-conditioning engineers are putting heat pipes to work pre-cooling or pre-heating fresh air entering buildings.

With their special ability to transport heat and distribute it evenly, heat-pipes are being used in computer circuits, industrial furnaces, spacecraft, and in automotive design applications, to name just a few. Scores of thousands of them are destined for use in the construction of the Alaska oil pipeline as detailed later in the article.

The heat-pipe isn't much to look at: a sealed tube containing a working fluid and a wick that just sits there and transfers heat. A pipe one inch in diameter and two feet long can transfer 13.2 megajoules an hour at 980deg C with only a 10deg temperature drop from end to end. That's about 1,000 times the efficiency of a solid silver bar the same size.

All you do is heat one end of the tube. The working fluid evaporates, absorbing large amounts of heat, and moves to the other end of the tube. There it condenses, giving up the heat and flowing back through the wick to start the cycle again.

Credit for inventing the heat pipe goes to Richard S. Glauger, a General Motors engineer who developed the idea in the 1940s. GM used the device in a refrigerator, but that was about it. The heat pipe was, in effect, reinvented in the early 1960s by George M. Grover of the Los Alamos Scientific Laboratory.

Bruce Marcus, TRW's manager of heat-pipe projects, points out that the Orbiting Astronomical Observatory (OAO) went into orbit in August, 1972, with four heat pipes aboard. Three of these help keep the optical system in thermal balance, while the fourth drains excess heat from the OAO's on-board computer.

Future spacecraft in which heat-pipes will be used extensively include the Viking Mars Landers and the Space Shuttle.

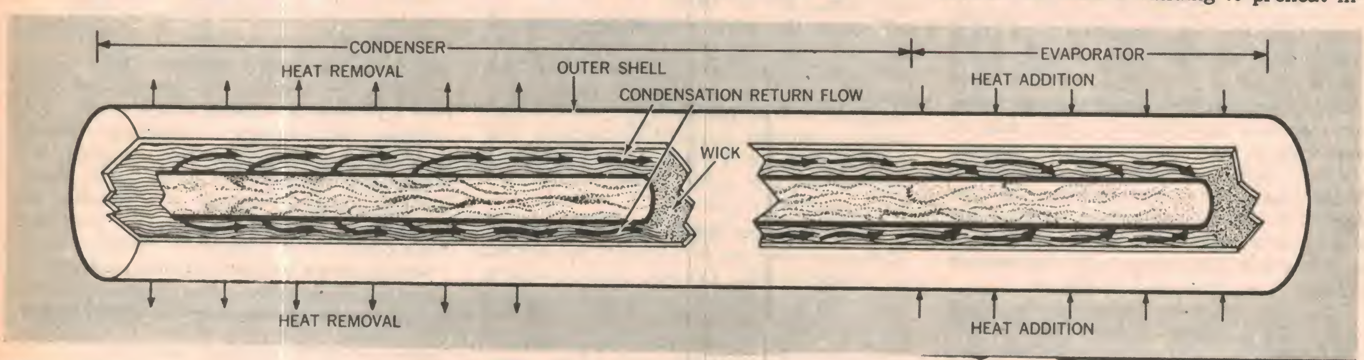
Despite early optimism about heat pipes, the 1960s are littered with the wreckage of corporate efforts to market the devices. Most of the big corporations — RCA, Litton Industries — that entered the field left it with a bloody nose. But a small New Jersey company, Isothermics Incorporated, is pinning its hopes on the Air-O-Space, a 15-pound gadget designed to be tacked on to a flue pipe. Heat pipes in the Air-O-Space draw waste heat out of the exhaust gas for use in basement or ground-floor rooms.

Air-O-Space seemed a natural for fuel-conscious homeowners, who were promised a savings of about $10 for every $100 in fuel they burned. But it didn't sell — at least not until this year, when the price of home heating oil suddenly zoomed.

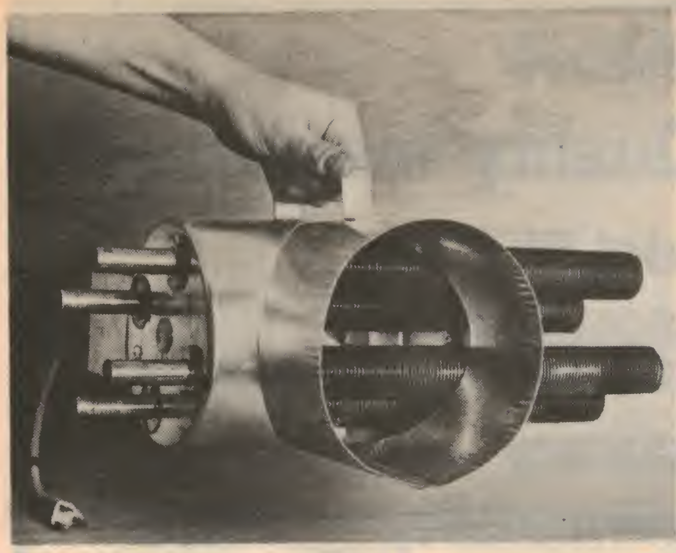
But the most promising applications of heat-pipe technology are in the heat-recovery business for industry. Heat-pipe engineers have their eyes on many processes — paint drying, textile processing, plant heating — where heat is used, then thrown away. One company making a bid for this business is Speizman Industries, a Charlotte, North Carolina, manufacturer of textile-plant equipment. Speizman has a number of systems that recover heat from hot exhaust gases, and use it to preheat incoming air or to heat water and lower heating costs. Pollution-control features can also clean and filter exhaust air.

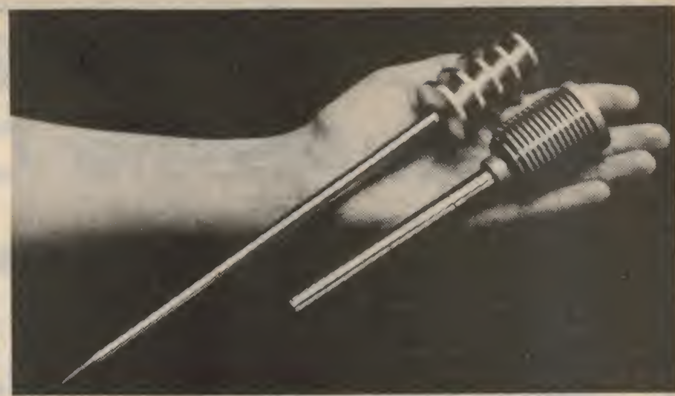
Alan Goldberg of Speizman believes that sales for heat-pipes will rise and fall in accordance with the prevailing state of the energy crisis. An initial outburst of interest was caused by panic about oil supplies, but faded as plant engineers managed to get through the winter. Now, however, interest is reviving due to the increased cost of heating oil.

The Dallas-based Q-dot Corporation also manufactures thermal-recovery hardware for heating and air-conditioning systems. Their Thermal Recovery Units (TRUs) use exhaust air from a building to preheat in-

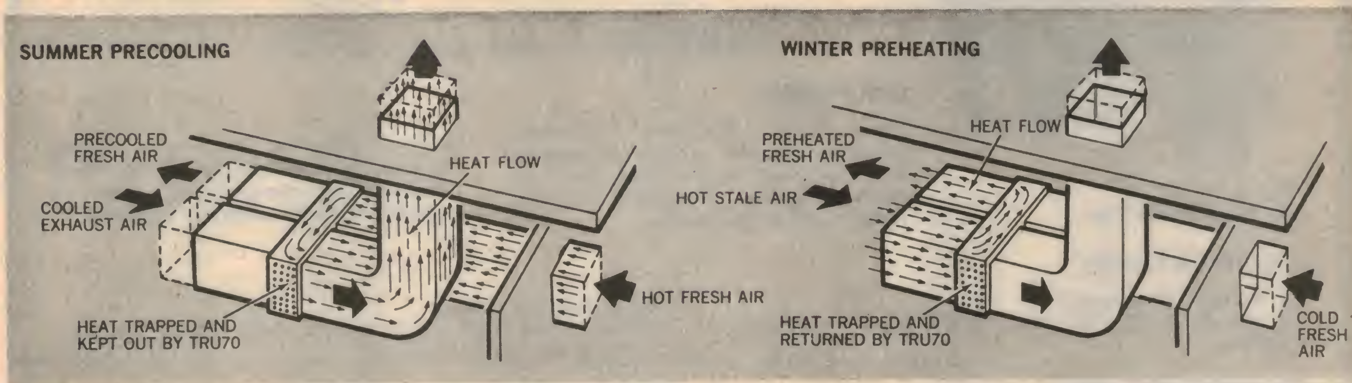


How a heat pipe works: heat input into one end of the pipe evaporates the wick fluid, driving the vapour to the condensor end of the pipe where it is condensed by the cooler inner walls. The condensed liquid is then returned to the evaporator end of the pipe by the wick's capillary pumping action. An enormous amount of heat is absorbed by the fluid as it evaporates.





At left is the heat pipe attachment developed by Isothermic for recovering waste heat from flue exhaust gases. Above are two more heat pipes intended for differing applications. The topmost device is designed to be inserted into a roast to reduce the cooking time, whilst the other device is designed to replace the dipstick in a motorcycle to help cool the oil.



This heat exchanger from Q-dot Corporation is used to precool or preheat fresh air entering a building to lessen the load on the heater / air conditioner. The system employs 144 3½-metre finned heat pipes which pass through a panel that separates incoming air from outgoing air. In summer, hot fresh air passes over one half of the pipes, while cool exhaust air from the building passes over the other half. The heat removed from the incoming air travels down the pipes and is vented with the outgoing air. In winter, the heat removed from the warm exhaust air travels down the pipes to preheat incoming cold air.

coming air in the winter or, alternatively, to remove heat from summer air. In typical installations, up to 70 percent of the waste heat is recovered and reused.

In addition to their obvious applications in heat recovery and transfer, heat pipes are also receiving a great deal of attention because of their unique ability to distribute heat evenly. Dynatherm Corporation of Cockeysville, Maryland, is currently manufacturing a heat-pipe furnace for the semiconductor industry which not only requires high temperatures — from 1,100deg C upwards — but also even temperature distributions for such delicate operations as doping semiconductor materials and putting a thin layer of one crystal on top of another.

"If the temperature varies along the line, the crystal material in the higher-temperature zone will have a different reaction rate," explains Alan Streb of Dynatherm. "The current practice is to use electronic controls alongside the working zone, but at best you get a W-shaped (irregular) temperature profile through the furnace."

By using a tubular heat pipe as the wall of the furnace, Streb reports, "We can achieve a uniform temperature that matches our ability to measure temperature — one-tenth of a degree over the entire zone." Unhappily, he says, the furnace can only go to 1,000deg C (about 2000deg F) — not because of the heat pipe, but because no available material can withstand higher temperatures. "If we could find materials that would enable us to go to 1,250deg C, it would open a vast market for us, because a large part of semiconductor processing is done just above 1,100deg C," Streb says.

A more prosaic heat-pipe product developed by Thermo Electron Corporation is a restaurant griddle. Outwardly, this is an ordinary griddle that a cook uses to "rustle up an order of hamburgers." But the surface of this griddle forms the upper wall of a planar heat pipe that's about an inch thick, and heated by gas jets below. The heat-pipe griddle will give cooks more even heat distribution and faster heat-up time at a lower price than conventional griddles.

But many heat-pipe applications won't be nearly so visible. If you run a large computer system right now, the odds are that a small heat pipe forms part of the cooling system.

MacLean Engineering Laboratories has been getting into heat-pipe equipment with enthusiasm. Heat-pipe coolers offer freedom from water pipes which must be used in conventional heat exchangers to carry off the heat, and which always bring the risk of equipment-damaging leaks. A heat-pipe system costs twice as much as a conventional heat exchanger, but eliminates water pipes.

One project that fascinates both McLean and Isothermics is the union of the heat pipe and the rotary heat exchanger, a revolutionary new device that uses spinning fins to get double the efficiency of conventional heat exchangers. By making the fins into heat pipes, engineers hope to eliminate the need for running coolant through the rotary heat exchanger, thus making it even more efficient.

One heat-pipe application that should be clearly visible in the next five years involves the Alaska oil pipeline. The Alyeska Pipeline Service Corporation plans to use a heat pipe every 1-2 metres along the 640km length of the pipeline. These heat-pipes, ranging from 10-20 metres in length, will go into piles sunk into the Alaskan permafrost. Their function will be to extract heat out of the permafrost to keep it from thawing due to the proximity of the pipeline.

Five companies are competing for the production of anywhere between 80,000 and 120,000 heat pipes for the Alaska oil pipeline. Both in number and in dollar value — Alyeska isn't saying, but it could be in the neighbourhood of $US30 million — this would be as much heat-pipe business as the industry has had to date. It's probable that the contract will be split among several companies, giving heat-pipes an enormous boost.

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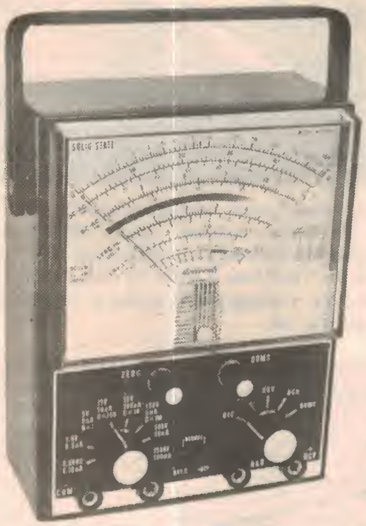

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Peak to Peak Voltage (7 ranges)
4, 14, 40, 140, 400, 1400, 4000V

dB Ranges (6 ranges)
-6/0/+66dB (Ref 1mW in 600 ohms)

DC Current (8 ranges)
0.15uA, 0.5uA, 5uA, 50uA, 500uA, 5mA, 50mA, 500mA. (Terminal voltage 300mV)

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Rx1 0-1k (10 ohm centre). Rx100 0-100k (1k ohm centre). Rx1k 0-1M (10k ohm centre). Rx1M 0-1000M (10M ohm centre).

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Square Wave Oscillator/Pulse Generator uses 555 IC

With a little care, the popular 555 monolithic timer IC can be used as a square wave oscillator or variable duty cycle pulse generator. The circuits and design details are given in this short note.

by ALAN M. FOWLER*

The popular 555 timer IC can be connected as an oscillator, as shown in Fig. 1. The capacitor C is charged by current flowing through R1 and R2 in series, and the time the output is high will be given by:

$$T1 = 0.685(R1 + R2)C \text{ seconds.}$$

where the resistance is in megohms and the capacitance in microfarads.

At the end of this time, a ground is applied

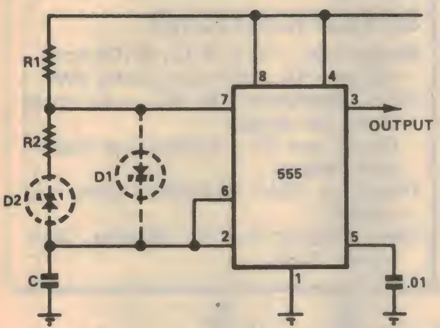


FIG. 1

to pin 7 from within the device, and the capacitor is discharged through R2 in a time:

$$T2 = 0.685R2C \text{ seconds.}$$

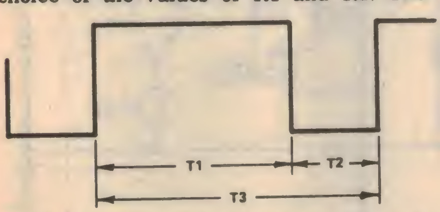
The pulse repetition time will therefore be:

$$T3 = 0.685(R1 + 2R2)C \text{ seconds.}$$

With this simple circuit, the duty cycle, or the ratio of the pulse "ON" time to repetition time will be:

$$(R1 + R2) / (R1 + 2R2)$$

The duty cycle can be set from slightly more than 50pc to nearly 100pc by a suitable choice of the values of R1 and R2. The



lowest value of R2 will be determined by the maximum current that may flow into pin 7 without exceeding the dissipation rating, when it is held low during the discharge cycle.

The addition of the diode D1 (shown dotted) between pins 6 and 7, allows the capacitor to charge through R1 only, and discharge through R2, so the duty cycle is now R1 / (R1 + R2). It can therefore be varied over almost the full range from 0 to 100pc. The charge time will not be completely independent of R2, as some current will flow through it due to the voltage drop across D1. This problem can be overcome by inserting a second diode D2 in series with the lower end of R2.

Two applications of this circuit are a fixed frequency, variable pulse width oscillator, Fig. 2, and a wide range square wave generator, Fig. 3.

VARIABLE PULSE WIDTH OSCILLATOR.

As the repetition time is set by the sum of R1 + R2, and the duty cycle by R1/(R1 + R2), the two resistors may be replaced by a potentiometer so that the duty cycle may be varied from 0 to 100pc without changing the repetition time (or frequency). R3 must be included to limit the maximum current into pin 7, and this will determine the minimum pulse width. In practice there is a small variation in the repetition rate, but this is of little importance in applications such as a pulse width control to vary the speed of a DC motor.

WIDE RANGE WAVE GENERATOR.

If R1 and R2 in Fig. 1 are both varied, but remain equal in value, the repetition rate will be varied, while the output remains a square wave. A suitable circuit is shown in Fig. 3. Resistor R3 is again added to limit the maximum current into pin 7, and R4 must then be included to balance its effect so that (R1 + R3) = (R2 + R4).

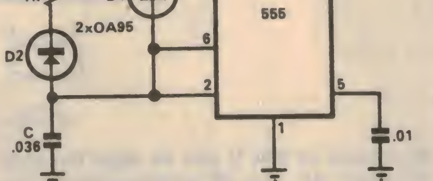


FIG. 3

The limits of the frequency range are given by:

$$F\,min = 0.73/(R1 + R3) \text{ Hz.}$$

$$F\,max = 0.73/R3C \text{ Hz.}$$

and their ratio is (R1 + R3)/R3.

For the values shown in Fig. 3, the lowest frequency is 40 Hz, and the highest 20 kHz, with a range of 500:1.

The output will only be a square wave if R1 and R2 track exactly. The maximum error is likely to occur if a log. potentiometer is used, to avoid crowding the frequencies at one end of the scale. This type of potentiometer is usually made with two linear segments so that it approximates a logarithmic curve, and the tracking error is likely to be biggest at the crossover

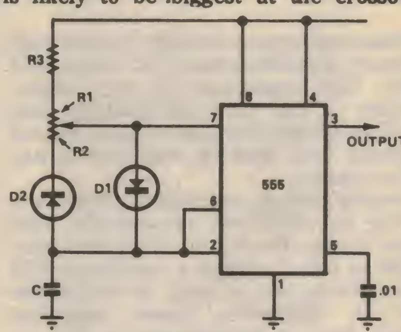


FIG. 2

between the two segments. In practice, the ratio of off to on time may vary to as much as 40 : 60 instead of 50 : 50 over this part of the range. If a reasonably accurate square wave is needed over the full range, linear potentiometers will provide closer tracking

*"Whitethorn", 3 Lemon Road, North Balwyn, Victoria 3104.

High Impedance Voltmeter based on low cost Op Amp

Here is an easily built high impedance electronic voltmeter using a single 741 op amp IC. While the basic instrument is designed for DC measurements, probes are also described to allow its use for measuring both RF and low frequency AC signals.

by F. G. CANNING, FIREE (Aust) *

When working on solid-state circuits there are many occasions when a DC voltmeter of really high resistance is very useful, because it can give substantially true readings in high-resistance circuits without upsetting their working conditions to any serious extent.

Needing such an instrument quickly and having no calibrated vacuum-tube voltmeter handy, the writer considered what might be done by using a 1-milliamp FSD meter which was on hand, in conjunction with an inexpensive linear integrated circuit. Such an arrangement has the advantage, apart from the possibility of high input resistance, that calibration is unnecessary if accurate resistors are available, because a reading of one milliamp full scale can easily be made to mean one volt, with other ranges in proportion merely by switching one resistor. Accuracy and stability can be very good because of the large amount on negative feedback employed with the integrated circuit. Furthermore, a 1-milliamp meter is cheaper and much more robust than those of ten or twenty times greater sensitivity which are usually found in normal high-resistance voltmeters — which, in any case, will have a resistance seldom exceeding half a megohm on the lower ranges.

Having worked out the details of such a DC instrument, the idea of extending its usefulness to radio-frequencies and, consequently, to AC voltage measurements presented itself. The need here was for an RF voltmeter of low losses, low capacity, and an input impedance of several megohms, which could be applied to a tuned circuit or oscillator while leaving its "Q" almost unaffected. Therefore it was arranged that an AC or RF probe on a long flexible lead could be plugged into the DC instrument, the probe containing a full-wave peak-to-peak rectifier circuit using low-loss materials. It was then only necessary to change one resistor in series with the meter movement by a DC-AC switch to have the meter show RMS values of AC voltage, with the original linear scale remaining accurate throughout except for the first one-third of the 1-volt scale where the curvature of the rectifier characteristic produces increasing non-linearity. A calibration curve for this part of the scale is shown hereafter.

At first sight it seemed that one AC probe would suffice for both audio and radio frequencies. However, it was desired to extend the audio range with full accuracy down to 20Hz and this required capacitors of 1uF in the rectifier circuit. Flat lacquered polyester-foil capacitors were used here and were quite satisfactory at the lower frequencies, but it was feared that their losses would be too high at radio frequencies, where much smaller capacity would in any case be sufficient.

Since low RF losses were an essential requirement of the project, a second probe was made for this work, using small polystyrene-foil capacitors and glass-fibre insulation, designed for frequencies from 100kHz upwards; while the other probe covers the range 20Hz to 200kHz.

Fig 1 shows the circuit of the DC instrument and Fig 2 the two probe circuits. Note that the low-frequency probe has a DC-AC switch so that it can be used for both purposes. AC and RF measurements are confined to the 1-volt and 10-volt ranges only, as anything exceeding 40 volts RMS could break down the rectifier diodes in the probes.

THE INTEGRATED CIRCUIT

For readers who may not be very familiar with these devices, a very brief explanation may be in order. The type of IC used here is called an operational amplifier. Originally devised for carrying out certain mathematical operations in computer work, it is now used increasingly for all sorts of linear amplification purposes in both DC and AC circuits, and for these purposes it has potent advantages in space, cost, simplicity, stability and economy of working current.

An operational amplifier of this type is, in essentials, a direct-coupled multi-stage DC transistor amplifier of very high overall gain, intended specifically to be used with very heavy negative feedback. The initial gain, called open-loop gain, may be anything from around 2000 times to 200,000 times or more, depending on the type chosen, but the gain after feedback is applied, called the closed-loop gain, is seldom required to be more than 1000 times and is commonly much less.

This massive negative feedback not only extends the frequency response and reduces distortion and noise in the usual manner of NFB; it also makes the whole circuit largely independent of manufacturing tolerances in the IC itself and in its supply voltages. As a result, its performance in a

SPECIFICATIONS

Ranges: DC — 0-1, 0-10, 0-100 volts.
AC and RF — 0-1, 0-10 volts RMS

Input Impedance: On DC — 22 megohms, all ranges.
On AC and RF — 5 megohms approx, both ranges.

Frequency: 20Hz to 50MHz, using two probes

Power Supply: 2 x 9V batteries. Drain approx 2mA.

Complete circuit of the Op Amp voltmeter. The required range is selected by varying the feedback network. AC and RF voltages may be measured by means of external probes. (See Fig. 2)

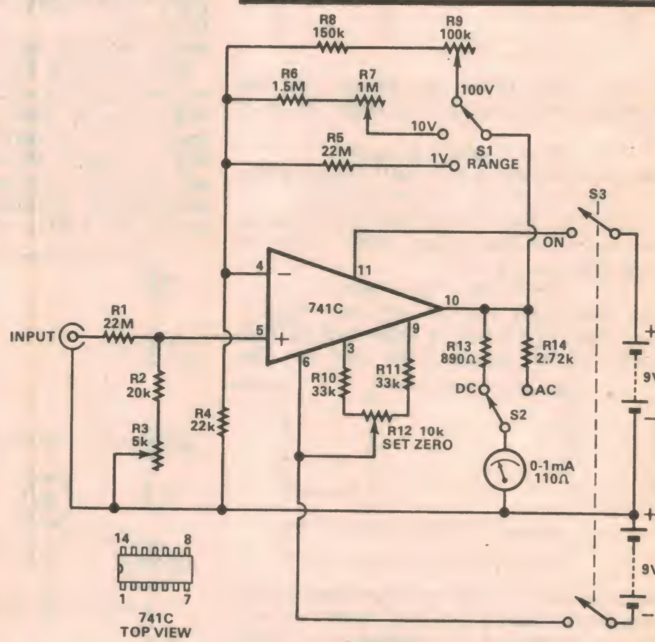


FIG. 1

*30 Back Beach Road, Portsea, Victoria 3944.

given circuit can be predicted and determined almost completely by the choice of the external feed-back components. Feedback can be either DC as in the present design, or AC as in the case of preamplifiers for audio frequency work, or both. There are, however, frequency limitations depending upon the type of IC chosen and very few are useful beyond a megahertz or so irrespective of the amount of feedback used. They are, as previously said, primarily DC amplifiers.

Usually an operational amplifier, or "op-amp", has two inputs and one output, plus a few other connections for supply voltages and other purposes. The input connections are called "inverting" and "non-inverting" inputs respectively, meaning simply that an input signal applied to either of them will appear at the output terminal either with the same or with the opposite polarity, according to choice of input terminal. To avoid drawing the whole complex internal circuit of the IC, the symbol shown in Fig 3 is used to represent it, namely, a triangle placed sideways with inputs on the left and output at the apex on the right. The inputs are labelled "+" for the non-inverting one and "—" for the inverting one. A signal applied to the "+" input appears at the output in phase with the input; if applied to the "—" input the output is in phase opposition; ie, there is phase reversal.

Fig 3 shows the two basic circuits for an "op-amp". In 3a showing the "inverted" circuit, the input goes through R1 to the inverting terminal and negative feed-back is applied through R2 to the same terminal. If the source of the signal has low impedance, the closed-loop gain of this system is, practically, R2/R1 and by varying R2 it can be made almost anything from unity up to the full open-loop gain. The input impedance of this arrangement is relatively low — virtually equal to R1 — and its output impedance fairly high; these properties are useful in many circuits but not for the present application where we need very high input and low output impedances, the latter to suit the low resistance of the milliammeter.

We therefore turn to Fig 3b, showing the non-inverting configuration. Here we feed the signal into the "+" terminal, but the feedback remains connected to the inverting terminal. The closed-loop gain will now be equal to R3/R2 and the input impedance will be high — several megohms at least — and output impedance 75 ohms or less. These characteristics evidently suit our present purpose and this circuit was chosen.

Several types of linear op-amps are available at moderate prices having widely-different characteristics. For this instrument the popular type 741 seemed most suitable. This is quite a complex affair containing twenty transistors, many resistors and a capacitor for frequency compensation and having a typical open-loop gain of 200,000 times. It is available either in a TO99 round can or as 14-pin or 8-pin dual-in-line packages; the 14-pin version was chosen. A second version, type 741C, is often available and sometimes at a rather lower price; this appears to be a so-called "Commercial" version with somewhat looser tolerances, but it has been found quite satisfactory and is used in this instrument. A constructor may use whichever type suits him or is procurable, and the package version desired.

The practical circuit evolved into that

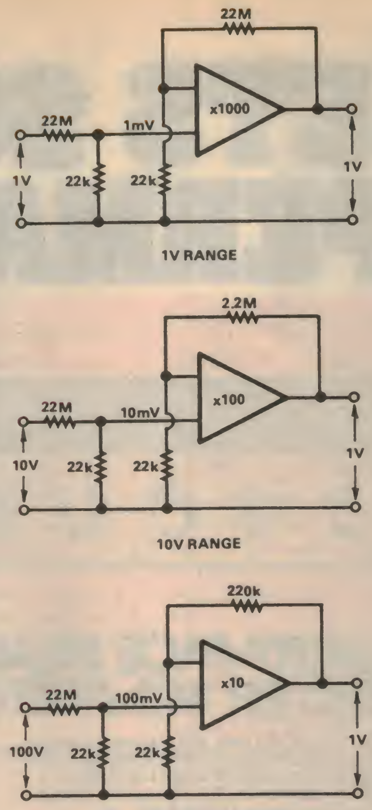


FIG: 4 100V RANGE

Showing how the meter ranges are provided by changing the feedback resistor values. Values for other ranges can be calculated.

shown in Fig 1. Starting with the meter, we connect in series with it a resistor of a value which, together with the meter's internal resistance, will total 1000 ohms and thus give a full-scale deflection (1mA) with 1 volt applied across them. This will be the output required from the op-amp on all ranges and the meter scale divisions can be read as volts or fractions of a volt, multiplied by the range switch setting. The meter used here is an imported one of SEW make, type MR-85P with square face measuring 4⅝ x 4 3/16 inches, and its measured resistance was 110 ohms, requiring a series resistoe of 890 ohms. This can be made with sufficient accuracy from 820 ohms and 68 ohms in series, both of 1pc tolerance, these being preferred values. (R13 Fig 1.)

While a large meter like this one is nice to work with, easily read and robust, any 1mA meter can be used. If its internal resistance is not known or cannot be measured, it can be calibrated in terms of whatever 1 volt standard meter may be available, using a variable pre-set trimmer resistor of around 2000 ohms as the series resistor; the accuracy will then be no better than that of the standard voltmeter used.

It was desired to have a DC input resistance of at least 20 megohms, this being determined by R1. The nearest preferred value is 22 megohms and the required tolerance is 1pc; this being difficult to procure, it was made up from two 10 megohm and one 2 megohm units of 1pc in series. Both input circuits of the op-amp have to be returned to the earth line through resistors of only moderate value and of the same resistance, otherwise the slightly differing input currents can set up standing voltages large enough to make zero-balancing difficult. Thus R2 and R3, taken together, form a voltage-divider with R1 which reduces the input signal applied to the op-amp; a value of 22k was considered the highest desirable. Thus an input of 1 volt will be reduced to 1 millivolt at the input of the 741.

Since this must produce an output of 1 volt for application to the meter, the 741 must give a gain of 1000 for this range and the feedback circuit on the inverting input must be proportioned accordingly. This input, as above-mentioned, must be returned to the earth line through a resistance similar to R2 + R3, namely 22k. Thus R4 is determined and the feedback resistor R5 then automatically becomes 22 megohms, the ratio of R4 to R5 producing the required gain of 1000.

For the 10 volt and 100 volt ranges it is only necessary to change the feedback resistor to increase feedback and reduce gain in the required ratio; thus R6 + R7 becomes 2.2 megohms for the 10 volt range

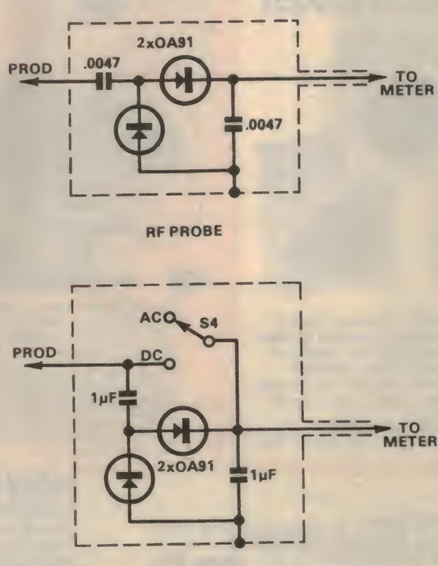


FIG. 2 AC-DC PROBE

Circuit for the RF and AC-DC probes to suit the voltmeter. Each probe is constructed in a small IF transformer can.

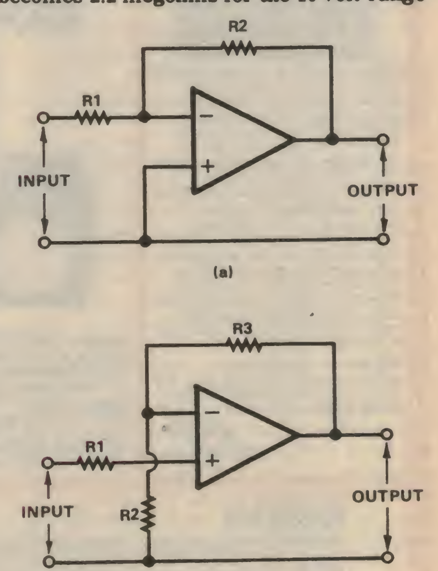


FIG. 3 (b)

The final circuit is based on (b). This gives a high input and low output impedance, ideal for this requirement.

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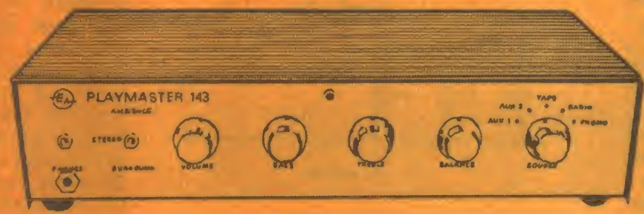
HE says I have to start answering your letters. O.K. I'll start next month. Meantime... Keep your iron hot —

Kit



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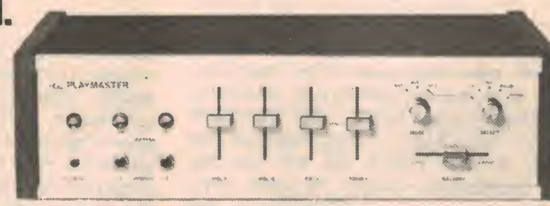

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and R8 + R9 becomes 220k to give the 100 volt range. These three conditions are shown in Fig 4 with the respective input and output voltages and gains indicated.

All resistors so far mentioned should ideally be of 1pc tolerance, and if these are available the accuracy of the instrument will be dependent only on that of the meter movement without further calibration. However, close tolerance resistors may sometimes be hard to get, so variable preset resistors have been added at the signal input (R3) and the 10 volt and 100 volt feedback resistors (R7 and R9) to permit exact adjustment, either to the required tolerance on a bridge or by direct comparison with another voltmeter. These can be miniature carbon trim-pots if low cost is important but they are awkward for precise adjustment and of doubtful stability of setting. A much better solution is the miniature Cermet trim-pot of the 10-turn type as made by Spectrol, Beckman, Morganite and others; these are probably worth the extra cost in terms of accuracy and stability.

It is necessary, in order to bring the output voltage to zero in the absence of an input signal, to balance the input currents of the two input terminals. Provision is made for this in the internal circuit by connecting a potentiometer (R12) across terminals 3 and 9, with its slider going to the negative supply rail (terminal 6). Additional resistors R10 and R11 were found desirable to make the adjustment less critical. R12 is a panel control with a suitable knob, used to set the meter reading to zero on the 1 volt DC scale only; this setting holds good on all other ranges. It is quite stable and shows very little drift after a few minutes' warmup, but it may be checked occasionally when great accuracy is called for.

AC AND RF RANGES

As stated earlier, the rectifier system in the probes actually produces a DC output proportional to the peak-to-peak value of the measured AC voltage, which is roughly 2.83 times the RMS voltage. If applied to the DC voltmeter circuit as it stands, the scale readings would have to be divided by this factor, a very awkward procedure, or else the meter would have to be re-calibrated with an additional peak-to-peak AC scale; both expedients to be avoided. The alternative is to reduce the milliammeter sensitivity until it reads the RMS value of the peak-to-peak voltage, thus preserving the original single scale for all purposes. This can be easily done by changing the multiplying resistor in series with the meter, and switch S2 does this by bringing in R14 to replace R13. Its value can easily be calculated.

The combined resistance of the meter and R14 must now be 1000 x 2.83, or 2830 ohms; subtracting the meter's internal resistance of 110 ohms (in this case) gives 2720 ohms for R14. If desired, this could be made a variable resistor to permit fullscale deflection to be adjusted on the 10 volt scale by comparison with another AC voltmeter, but most such voltmeters (of the rectifier type) are not accurate to better than 4 or 5pc and the use of the calculated resistor value is likely to give greater accuracy.

As mentioned earlier, the lower one-third of the 1V AC scale becomes non-linear, but the curve of Fig 5 shows that this is not serious. Nevertheless, the curve gives quite accurate correction down to 0.1V RMS at least.

It is worth remembering that by leaving S2 in the DC position while measuring AC, one gets, effectively, the peak-to-peak reading instead of RMS. In other words the sensitivity is increased by the factor 2.83 and although the scale is not calibrated for it, this increase is often quite useful for comparative readings of RF voltages too small to be read comfortably on the RMS scale.

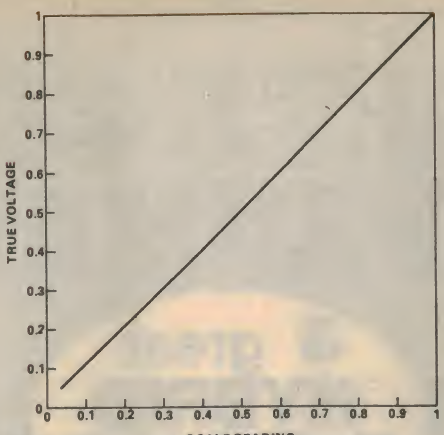

FIG. 5

Correction curve for the 1V AC range. Although the error is small this curve will correct for it where it may be important.

The effective input impedance is lower when using the RF and AF probes. For the peak-to-peak rectifier arrangement used the effective load presented to the circuit under measurement is usually taken to be one-quarter of the DC load resistance, in this case 22 megohms (R1). Thus the AC and RF probes load the circuit under measurement with about 5 megohms, with a few picofarads of capacity in parallel; this is negligible for most tuned circuits.

Two small 9-volt transistor radio batteries are adequate for the supply and as the total drain is only around 2 milliamps their life will be long. Lower voltages down to perhaps 3 volts could be used without much effect on performance but the 9 volt supplies are recommended. Note that both positive and negative supplies are needed.

RF AND AC PROBES

These are of similar construction, the only difference being in the size of the capacitors, the insulation used and the provision of an AC-DC switch on the AC probe, allowing it to be used for DC measurements without changing cables. Fig 2 shows the circuits.

Each probe is assembled in a square IF transformer can about 1⅛in square by 2½in high. The open end carries the insulating panel supporting the whole circuit assembly and a sharp 1¼in spike to serve as a prod, while the shielded coaxial cable carrying the DC output to the meter is brought out through a hole in the solid end of the can. The shielded co-ax cable is essential here to avoid pick-up of spurious signals, hum, etc, because of the very high input resistance of the meter circuit. It is about two feet long for convenience and is terminated at the meter end with any small coaxial connector of good insulation resistance, to suit a matching socket on the front panel.

The diodes in both probes are type OA91, of the germanium point-contact type, with a peak voltage rating of about 115 volts. They are chosen in preference to silicon types, firstly because point-contact types are usable to higher radio-frequencies than other constructions; secondly, because their conductivity starts at lower voltage than silicon types, thus contributing to better sensitivity and scale linearity; and thirdly, because their slightly higher leakage gives faster response and quicker recovery after a momentary overload. Silicon diodes of good quality have such low leakage that if the probe capacitors accumulate an overload charge it takes quite a time to leak away, and in the meantime the meter is paralysed.

Capacitors in the RF probe are small tubular polystyrene types (not polyester) of excellent "Q" and insulation. Uncased silvered-mica types would be equally good but probably more bulky, and most available mica capacitors seem to come in "moulded mud" cases whose RF losses are not to be trusted. Ceramic capacitors are quite unsuitable because of high RF losses and should not be used.

The AC-DC probe uses flat lacquer-coated polyester foil capacitors of 1uF which fit the can fairly snugly; the writer used "ELNA" brand. This probe has a miniature slide-switch of the smallest available size mounted on one side wall, to change the probe from AC to DC operation simply by

PARTS LIST

RESISTORS

R1 22 megohms, 1pc (see text)
R2 20k 5pc
R3 5k linear trim-pot
R4 22k 1pc
R5 22 megohms, 1pc (see text)
R6 1.5 megohm, 5pc
R7 1 megohm linear trim-pot
R8 150k 5pc
R9 100k linear trim-pot
R10, R11 33k 10pc
R12 10k linear potentiometer, panel mounting
R13 890 ohms, 1pc (see text)
R14 2720 ohms, 1pc (see text)
All fixed resistors are ½ watt carbon film or metal oxide film

CAPACITORS

2 5000pF, tubular polystyrene pigtail type
2 1uF flat lacquered polyester foil, 200VW

SEMICONDUCTORS

1 Integrated circuit operational amplifier, uA741C
4 Diodes, OA91 or similar

MISCELLANEOUS

Meter: 0-1 milliamp, SEW Type MR-85P or similar, to choice
S3, S4 Miniature slide switches
S1 Any small one-pole three-way switch, panel mounting
S2 Miniature slide switch
1 Small coaxial socket, panel mounting
2 Coaxial plugs, to suit above
1 14-pin DIL socket
2 1-inch knobs, to choice
2 IF transformer cans, approx 1⅛" square x 2¼" high
4 feet of 3.5mm screened and PVC sheathed coaxial cable
2 9-volt transistor radio batteries, P1 size
2 battery connectors for above
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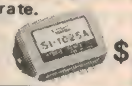

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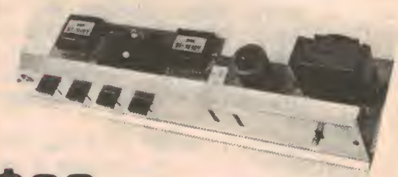

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VOLTMETER

shorting input to output. The prod consists of a 1½in length of 6BA threaded brass rod, sharpened to a point at one end and mounted at the other by nuts in the centre of a square panel of insulating material. The latter is mounted over the open end of the can by whatever mounting means are provided — lugs, spade bolts, or whatever.

The AC-DC probe used 1/16in bakelite sheet for this panel, but in the RF probe a piece of polyester-glass-fibre sheet salvaged from a high-quality printed circuit was used. Sheet polystyrene would have lower losses but is hard to find and ceramic materials, also good, are too difficult to work.

Inside the can the components are supported on a vertical panel of the same material, cut to fit the internal dimensions of the can and mounted to the top panel by a generous fillet of Araldite adhesive or else by small lugs and bolts. No specific constructional details are given as so much depends on the components actually available.

The AC-DC probe will need careful arrangement to leave room for the switch without fouling the rather large capacitors. For the screened leads the writer used PVC insulated, screened and PVC sheathed coaxial cable of 3.5mm overall diameter — a pleasantly flexible size which imposes minimum strain on the meter. A short length of tinned-copper braid equipped with an alligator clip is attached to the probe can to serve as earth connection to the circuit being measured.

A useful accessory is a further alligator clip provided with a 6BA nut mounted coaxially on its shank; this can be screwed onto the prod when a temporary connection is needed to a circuit, so leaving both hands free.

CONSTRUCTION

The prototype is assembled on a sloping panel measuring 7¼ x 6in, set at a 30-degree angle on the front of a pine-board box of sufficient depth to house the batteries. Fig. 6 gives the panel layout.

The 741 IC is best used in a 14-pin DIL socket to avoid soldering directly to the IC pins, which can be a tricky job. These sockets exactly match the holes in 0.1in matrixboard or Veroboard, and their pins can easily be soldered to wires or strips on the reverse side. The writer favours Veroboard for this, and a suitable connection scheme for the circuit of Fig 1 is easily arrived at. If suitably dimensioned, this board, carrying most of the components, can be mounted directly on the meter terminals by loops of 18-gauge tinned copper wire.

Note carefully the small notch at one end of the 741 to identify it with the pin numbering diagram (see Fig 1). The socket should have a similar small notch at one end and the 741 must be inserted with the notches coinciding. There is nothing else to prevent the 741 being inserted back to front, which may do it no good at all. And when inserting or removing it, be very careful to do so with an absolutely straight pull or push, otherwise the fragile pins are almost certain to be crumpled or otherwise damaged, perhaps beyond repair. Once safely in its socket, the less it is moved the better, but the ability to remove it during servicing or circuit changes is a great advantage over permanent soldering into the circuit.

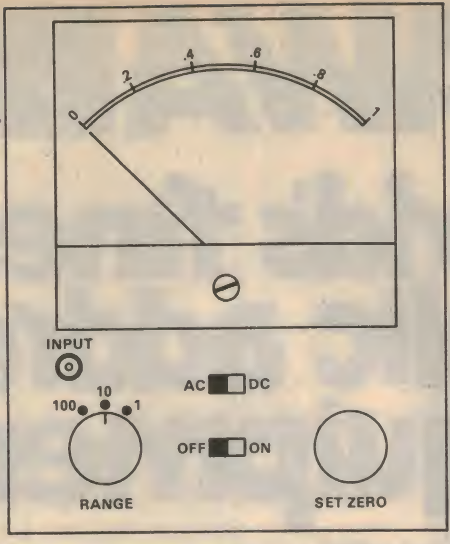

FIG. 6

The physical form of the finished meter is not critical, but the panel arrangement shown should serve as a guide.

The Range Switch S1 should preferably be a miniature rotary wafer type to conserve space. The "ON-OFF" switch S3 must be a double-pole type, to switch both batteries. For this and also for S2 the writer used small slide switches, again to save panel space.

Because the instrument is virtually self-calibrating if 1pc resistors have been used throughout, no special instructions are needed in that case.

If the suggested variable resistors have been included, two courses are open. If a Wheatstone Bridge is available or can be borrowed, each combination of fixed and variable resistor can be set up to the exact value needed before wiring into the circuit and further calibration is then unnecessary. The values required are

R2 + R3 = 22k
R6 + R7 = 2.2 megohms
R8 + R9 = 220k

R4 and R5 cannot well be made adjustable without badly complicating the scale-setting procedure; they must be of 1pc tolerance.

Failing the bridge, each DC range can be set at full-scale deflection by comparison with another voltmeter, starting with the 1 volt range. A supply of finely-adjustable voltage, or a potentiometer across a fixed supply can be used. The 1 volt range is best set up by feeding in an accurate one volt DC and adjusting R3 for full-scale reading, having first zeroed the pointer using the Zero Set knob R12. The 10 volt and 100 volt ranges can then be set up in succession by adjusting the appropriate resistor in the feedback chain (R7 and R9 respectively.)

With the DC ranges correct, the AC ranges should not need further calibration. However, if an AC voltmeter of known accuracy at 10 volts is available for comparison, the 10 volt AC range can, if desired, be set correctly at 10 volts full scale by using, say, a 5k variable resistor for R14. The 1 volt scale will then also be correct and both will be accurate when using the RF probe over its designed frequency range.

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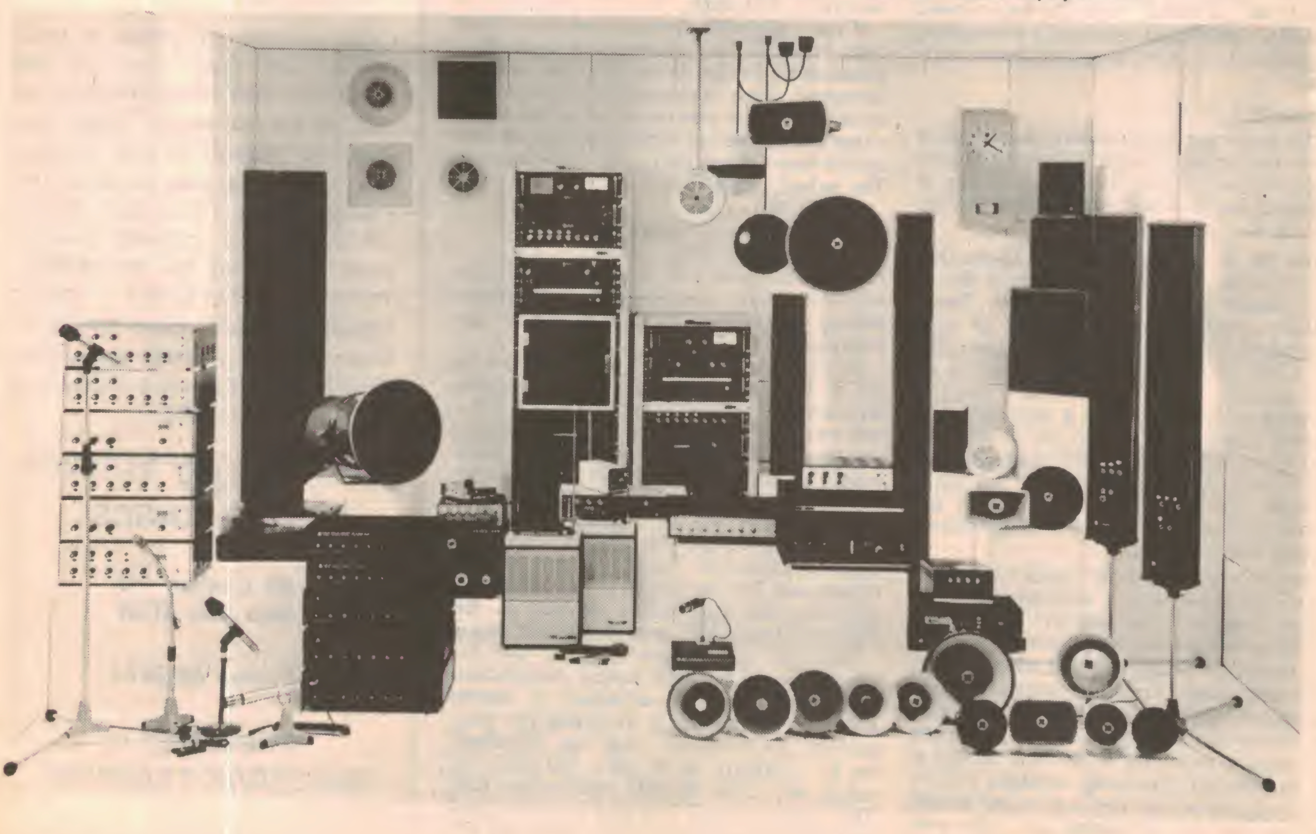

Letters to the editor

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

Favourite cassette

Being an avid reader of "Electronics Australia" I feel that I would like to contribute something to the magazine. Here then is a review of my favourite cassette:

SHANGRI-LA. Manuel & The Music Of The Mountains. Stereo, EMI TC-TWOX-1001 (Code 1704).

This is a very satisfactory cassette, as with most of Manuel's music. The tracks are the cleverest I have heard for a long time on any popular or not so popular cassette. All twelve tracks are well arranged and produced with a clarity of notes — and yet loud enough to give you a good signal on mid volume on most stereo players. Not real good for a car, though; it is good music for background or to study by. The tracks:

Canto De Ossanha — Clair De Lune — Celebration — Misty — The Gondolas Of Venice — El Condor Pasa — And I Love You So — What Are You Doing The Rest Of Your Life? — Flamingo — You Are The Sunshine Of My Life — Yesterday — Once More — The Road To Shangri-La.

If you are inclinded to like good music, you won't mind the price. (D.G.M.)

COMMENT: We have a full team of reviewers at present and would not be in a position to accept additional reviews for publication. However, your cassette has obviously given you so much pleasure that other readers may like to know about it.

Kirlian photography

I read with interest the article entitled "Kirlian Photography: A Puzzling Phenomenon", in your May issue. Being only an amateur, I couldn't understand all the technical talk, but having a grounding in physics and chemistry I got the gist of what was going on.

It was therefore with some amazement that whilst browsing through an early volume of Scientific American (October 17th, 1896), I found an article entitled "Photography by an electric discharge." The process seemed to be almost identical to that of Kirlian photography, although somewhat cruder. In fact the article had a picture of a coin which was very similar to that in E-A, although a little less clear and refined.

It just goes to show that there's nothing new under the sun!

T. Norman (Panorama, SA)

COMMENT: With the continuing information explosion, we wonder how many other early ideas have been re-invented!

The transitor?

While browsing through an early issue of the magazine — August, 1948, in fact — I came across a news story announcing the discovery of a new device to replace the valve. The story said that the device, developed by Drs Shockley, Bardeen and Brattain at Bell Laboratories, was called the "transitor".

Was this a typesetting error, or was "transitor" the first name used for transistors?

T. Quick, VK5ZTX (Hope Valley, SA)

COMMENT: It was most likely a typesetting error. To the best of our memory, the name "transistor" was used right from the start, being explained as a contraction of trans-resistor.

Colour TV decoder

Like myself, many readers must be very interested in the colour TV decoder design presented in the June issue. The design approach seems very well suited to local conditions. Will the article's sequel be appearing shortly?

We look forward to other articles on the subject of colour TV receivers, also.

While I am writing, I must congratulate you on the SSTV monitor project, also the home study course and the articles on various types of wideband AM tuners. You fellows up at Jones street have a first rate team; we never miss an issue.

R. L. Langdale
(Mt Eden, Auckland, NZ)

COMMENT: Many thanks for the kind words. Yes, we got a very good response to the colour TV decoder article, and certainly plan to run more when we can. Unfortunately Mr Pierson has been a little delayed, but we should be able to publish the sequel article very shortly now. (Note to those other readers who responded to our request for feedback: many thanks for writing, and your comments have been noted.)

Miniature tagboard

In Ian Pogson's article "A basic monitor for slow-scan television" in the May edition of your journal, he makes the following observation "Another small point on the same less optimistic note relates to miniature tag boards, which we have used on this unit and many others in the past. We are advised that this material is going off the market."

We are pleased to assure the author of this article and readers of your journal that following some shortage in the supply of the basic laminate, both miniature and standard terminal boards are now readily available.

Readers who are experiencing difficulty in obtaining supplies from their regular source are invited to contact the following distributors of Cinch Radio and Electronic Components.

Watkin Wynne Pty Ltd,
32 Falcon Street,
Crows Nest 2065.

GRA Electronics Pty Ltd,
528 Collins Street,
Melbourne 3000.

Gerard & Goodman Pty Ltd,
192-196 Rundle Street,
Adelaide 5000.

Atkins Carlyle Ltd,
894 Hay Street,
Perth 6000.

I hope this clarifies the position, and provides a welcome note of optimism.

H. R. Fennell, Marketing Manager,
Carr Fastener Pty Ltd,
Hendon, South Australia.

Computer project

Having just read with great interest your second article on the EDUC-8 computer, in Electronics Australia, September '74, I would like to point out a couple of mistakes.

First of all, you state that performing the CMA operate micro-instruction on a cleared AC will give the AC the value of 1. This should be —1.

Secondly, you state that the RAR instruction corresponds to a division of the AC by two. You fail to mention that this holds true only for those values of the AC which have Bit-0 as 0, that is, only even values.

Finally, I feel that if you were going to state in the text that Bit-4 input to the MA register is connected to the C-bus, you could have illustrated this point on the Basic Organisation diagram.

On the whole, however, I should like to congratulate you on an excellent and

imaginative project, and look forward to reading the remaining articles, and who knows, perhaps even making one.

Jonathan Etkins, Form 5, Trinity Grammar, Doncaster East, Vic.

COMMENT: You are quite correct with the first two points, of which one was a typesetting error. The qualification applying to the RAR-divide by two equivalence was a deliberate omission, to simplify the initial discussion; we plan to deal with this sort of programming detail in greater depth later on when the basic machine has been described. Your third point is rather puzzling, because the diagram on page 39 of the September issue clearly shows a serial input connection from the C-bus to the MA register.

Vortex cassette decks

I note with interest your articles on a stereo cassette deck using the Vortex mechanism. As a disenchanted purchaser of one of these mechanisms I feel I should warn readers of the apparent complete lack of spare parts backup for them.

I bought my unit from one of your advertisers some 18 months ago. It took some 6 months to get hold of circuits to build a deck. Then during bench testing I discovered severe wow, and this turned out to be due to the flywheel hole being some .005in out of concentricity.

This being 6 months after purchase, I realised that there would be no question of replacement under guarantee. I therefore moved to buy a capstan/flywheel from the original supplier. However they informed me that they kept no spares, and referred me to Panel Parts, the importer.

After a long wait I was assured that spare parts would soon be freely available. However I had still not received the parts when I had to visit Sydney in mid-July, and I phoned both the supplier and Panel Parts to try and hurry up matters. Panel Parts seemed sympathetic and promised to send the part by post in "a few days". However it is September 2 as I write this, and I have still not received the parts necessary to get my deck going.

The Vortex mechanism will no doubt sell strongly as the result of your articles. Don't you think it is the responsibility of the distributors to provide an adequate spare parts service for their product?

L. Howard (Melbourne, Vic.).

COMMENT: Until now the situation seems to have been quite unsatisfactory, we agree, and we sympathise with you. However we are assured by Panel Parts that the spare parts situation is being cleaned up very rapidly. They claim that a good deal of the trouble has been due to suppliers who refused to be bothered with spares, despite the high mark-up they were apparently making.

Fast PC etching

I think it is only fair for you to draw the attention of your readers who might want to try this method (Circuit Ideas, Electronics Australia, June, 1974, page 75) to the warning given in the correspondence column of Wireless World, May, 1974, page 150 on the same subject.

I am quite sure that you do not wish to lose your readers through chemical poisoning! I would suggest that your readers stick to the less hazardous ferric chloride method which has stood the test of time.

C. S. Soh, Singapore.

Classical Recordings

Reviewed by Julian Russell

Mozart — exquisite accompaniment

MOZART — Don Giovanni. Complete opera. Ingmar Wixell (Giovanni); Martina Arroyo (Anna); Stuart Burrows (Ottavio); Luigi Rono (Commandant); Kiri Te Kanawa (Elvira); Wladimiro Ganzarolli (Leporello); Richard van Allen (Masetto); Mirella Freni (Zerlina) with the Royal Opera House, Covent Garden, Chorus and Orchestra conducted by Colin Davis. Philips Stereo 6707 022. (Four Discs.)

I wrote in a recent issue that to cast a perfect Don Giovanni is just about impossible. Perfection can be approached pretty closely but there will inevitably be a flaw somewhere. There may be an ambiguous characterisation, eg singers who have beautiful voices but no sense of Mozartian style, or vice versa. Then again a conductor might take some of the numbers at a tempo that others might disapprove of or excel in accompaniment but lack discipline in the finales. If ever there was an opera, the performance of which is wide open to challenge, it is Don Giovanni.

Colin Davis is a Mozartian of indisputable authority. He remains one in this new issue. But there were times when, listening to it carefully, I thought I detected here and there not only some unnecessary hurrying but also a strain or a tenseness that deprived passages of some of their elegance. Whatever the reasons for these slight aberrations, they tend to make admirers of Davis eager to anticipate delight in what they are about to hear and a little uneasy when their idol lets them down, however gently he might do it. But having said all this I can go on to the many merits of this production.

There are many times when Davis produces so exquisite an accompaniment that, at that moment, one is more than ready to forgive him every little shortcoming I have been churlish to mention. His instinct for a Mozartian subtlety is as fine as can be found today. He can woo with as much conviction as he can score a humorous point. Under his direction the music, though you may not agree with all of his treatment, never becomes boring.

But in this set, however indulgent one might feel towards Davis, tolerance is stretched very much further by a cast that, to put it as gently as possible, is uneven. Like John Pringle in our local Australian Opera's current production, Ingvar Wixell tends to make the title role altogether too engaging a personality. He is amiability itself, a thoroughly nice, easy-going fellow who might well grace any drawing room so long as the daughters or mistresses of the house did not appeal to his amorous instincts. True, if they did, beware. But Wixell, as does Pringle, never completely succeeds in conveying the more sinister cruelty and heartlessness of the man. Despite the plaints of his victims, one is left feeling that they were as much to blame as their betrayer. And in this context, no one has ever been able to decide whether or not he succeeded in ravishing Donna Anna. Personally I always feel that her lofty indignation might be raised on very meagre grounds, but no one will ever know for sure. At any rate, in this production Martina Arroya makes the character a very formidable one indeed. Her hauteur is sublime, her sense of outrage in the grand manner, though she never allows this to distort the beauty of her music and singing.

That other victim, Donna Elvira, in the person of Kiri Te Kanawa, offers a different, and very effective contrast in her oscillations between regret and anger and here there is no doubt about what happened during those three days in Burgos. She manages to convey without ambiguity that her anger is as much at her own weakness as her betrayer's skill. Occasionally she steps momentarily out of character — "Ah, Fuggi" is an example. Otherwise there is no mistaking her complex motivations.

The other lady in the case, the peasant girl Zerlina, is all charm and, sometimes, wilful provocation. As they used to say, she can always twist her new husband, Masetto, round her little finger.

That brings us to the other men, and here in my opinion the outstanding performance comes from that stooge-like character Don Ottavio (Stuart Burrows).

He is portrayed as a mettlesome fellow instead of a mere ineffectual swain of Donna Anna. Nowadays I always compare the Leporello to Geraint Evans' performance I heard in Amsterdam some years ago. At an hour's notice he was flown there from London and gobbled up the rest of the by no means inconsiderable cast without the slightest apparent effort. I cannot say the same, alas, for Wladimiro Ganzarolli's account of the role in this set. His characterisation is too often indecisive and his diction leaves plenty of room for improvement. On the other hand, Luigi Roni as the Commandant never falters in his powerful authority, backed by vocal attainments to match.

So here we have a production utterly charming in some aspects, slightly disappointing in others that might — though I don't know how — have been made into a better unity which would have offered more drama and more irony. However, at present there is only one other complete recording known to me that offers any real competition. I refer to Klemperer's. He takes a different view to Davis, making the piece darker in meaning despite the composer's insistence that it is a comedy. Again I must write that your preference for one at the expense of the other will be a very personal one. Indeed if you are lucky enough to be able to afford both, one might be said to complement the other.

This notice would not be complete without an enthusiastic mention of Richard van Allen's fine manly Masetto and John Constable's splendid continuo.

Schumann's Symphonies — splendid engineering

SCHUMANN — The Four Symphonies, in B Flat, C major, E Flat, G Minor, and the Overture, Scherzo and Finale in E Major, Op 52. DGG Stereo 2720 046-10.

These four symphonies, attractively offered in a white box, enjoy splendid engineering from ringing brass to whispered strings. There is also a grand sense of spaciousness in which the fine orchestra can expand. And expand it does. Even those who sometimes have reservations about a Karajan performance will find it difficult to fault him here. His identification with the music is complete, his playing full of the most gracious incidents. It is sturdy when necessary yet always mindful of Schumann's impulsiveness. True there are moments when long stretches of unchanging rhythm start to grow a little wearisome but that's in the character of the music and when he comes across them Karajan does his best to avoid monotony by subtle dynamic inflections.

To enumerate the many felicities of Karajan's — or his orchestra's — performances of these refreshing symphonies would be a bore to the many who regard them as mediocre examples of Schumann's oeuvre. To them, there was no symphonic composer between Mozart and Beethoven. If, like me, you are enthusiastic about Schumann's genius you will lose no time in acquiring a set.

The boxed set is accompanied by a brochure containing a perceptive analysis of "Schumann, 'a Failed Symphonist' " by Hanspeter Krellman. You may find it very useful to quote from it when contradicting Schumann's detractors. As to the often-used criticism of Schumann's weakness as an orchestrator, Karajan grandly overrides the charge. I cannot imagine a better set appearing for many a long year.

★ ★ ★

CHOPIN — Variations on "La ci darem." Fantasy on Polish Airs. Andante Spianato and Grande Polonaise in E Flat. Claudio Arrau and the London Philharmonic Orchestra conducted by Eliahu Inbal. Philips Stereo 6500 422.

Despite my admiration for Arrau's Chopin playing as expressed in a review of one of his records a couple of issues back, I regretfully admit that I was disappointed in him here. Despite much playing that is most comfortingly warm and romantic, Arrau seems to have deliberately estranged himself from the youthful ardour of these pieces. He once told me that he is reluctant to put too many rubatos into a recording. According to his theory, listeners of a

record grow to become aware of just where the rubatos are going to happen and this destroys the spontaneity of the performance. Things, he said, are different on the concert platform.

I think he has a valid point here, but in this recording he seems to carry it to extremes. His playing, despite its many beauties, sounds too closely considered, a shade too intellectual. He seems almost afraid to allow himself to become absolutely immersed in what he is producing. I haven't the space to enumerate every example but those who admired his previous Chopin as much as I did will instantly recognise what I mean.

Another incident that made me less than satisfied with the whole production is the clumsy turnover which cuts the Fantasy into halves. I can't see the necessity for this because, in my opinion, it could have been so easily avoided.

★ ★ ★

LISZT — Complete Concert Paraphrases on Operas by Verdi — Rigoletto; Ernani; Il Trovatore; I Lombardi; Aida; Don Carlos; and Simon Boccanegra. Claudio Arrau (pianist). Philips Stereo 6500 368.

When I was a boy, the Rigoletto Paraphrase was a popular concert item in every virtuoso pianist's repertoire. But nowadays it is seldom played. Indeed all Liszt's operatic paraphrases are dismissed by many as meretricious and mere vehicles for the display of empty virtuosity. Arrau presents the Rigoletto with all his usual good taste and faultless technique but plays down the virtuoso angle in his performance. His treatment is, to me, a trifle too serious and he seems to lack joy in his own great ability. But in the other paraphrases, if one excepts the Aida on the grounds of its slight lack of full-blooded enjoyment of its luscious melodies, Arrau is fine. The more serious the others, the better they sound under his magic fingers and their directing intelligence.

So please don't allow my remarks about the Rigoletto and Aida prevent you from acquiring this disc. The sound is superb and I, personally, would never be tempted to part with it. If you want to sample its splendours I suggest you try the Trovatore and the Don Carlos pieces where you will find ample compensations for the very, very slight shortcomings I mentioned above.

★ ★ ★

STRAVINSKY — Le Sacre du Printemps. Complete ballet. London Philharmonic Orchestra conducted by Bernard Haitink. Philips Stereo 6500 482.

If the opening notes on the bassoon and later other woodwind instruments sound a little too soft on your equipment don't turn up the gain. It is all part of Haitink's plan for the overall performance of the work. In these early bars he is expressing the mystery of a primitive, prehistoric world. Having done so he goes on to the first dance, its stamping rhythm brisk but never too hurried. And I think this is a good, although early, spot to mention the quite wonderful clarity of the engineering which avoids the trap of sounding like an X-ray account of the score, if you will allow me to mix my metaphors so atrociously. The dynamic range might well be wider than usual, hence my warning about the first bars, but I find it all the more eloquent for that reason. Stravinsky's music makes such a powerful physical assault on the senses that it should never be placed under restraint. Indeed most readers of this column will already be well acquainted with the riot it set off in Paris at its first performance by the Diaghileff Ballet.

Later Haitink makes the Dance of the Adolescents sound so lyrical that it is for a while almost languorous until interrupted by strident fortissimos. The whole performance is so vital, so full of mood changes, the complex rhythms and counter rhythms so wonderfully pointed that it grips the attention from beginning to end. And despite the amount of detail, the engineering, which if you are like me will knock you for a loop, never becomes dense. It remains open despite its often close bitonal elements.

Part 2 opens with what I can only describe as a marvel of sensitivity. The orchestra plays this difficult music with such ease that it might be a simple piece by Haydn. It becomes a great pagan acclamation of nature. This is one of the most exciting recordings of the many I have heard since the very first days of LP. Its mighty rhythmic thrust challenges one's own pulse to remain steady under the onslaught. To some the drums might seem to have been given a trifle too much prominence. But not to me. Every beat finds its target like a well-aimed missile. Without going into further detail this is a recording that I can recommend with the greatest enthusiam. You will also find inside the record container a very large early photograph of the composer that might well surprise many who have only seen him in later life.

★ ★ ★

RACHMANINOFF — Symphonic Dances. Caprice Bohemien. London Philharmonic Orchestra conducted by Edo de Waart. Philips Stereo 6500 362.

After the usual period of neglect that nowadays follows a composer's death Rachmaninoff's works are creeping back into favour — at any rate in the concert hall, because he has long been well represented in the record catalogue. There is too, of course, the Second Piano Concerto which has never lost its popularity and has even provided background music for the Noel Coward play, "Brief Encounter". But critics until recently have mostly treated Rachmaninoff's great concertos and other similarly fine music as the work of some modest understudy of Tchaikovsky. Rachmaninoff has now been dead for just over 30 years and not only is his public acclaim increasing but some of the most haughty critics now mention him with more respect — though in some cases still a little superciliously.

In his recording of Rachmaninoff's Symphonic Chances conductor Edo de Waart seems to belong to the latter group, at any rate in the lack of conviction he shows for the music. His treatment of the composer's juicier type of melodies deprives them of passion and the many changes of mood lack definition. I have only heard these Symphonic Dances once before in a resplendent recording of them by Kondrashin and the Moscow Philharmonic for EMI and that is the version I would unhesitatingly recommend as an alternative to the new Philips.

The Caprice Bohemien was new to me until I played the Philips disc. It is a kind of dance, like that at the beginning of Act 2 of Carmen — a theme that picks up speed as it goes along. I liked de Waart better in this item. But on the EMI disc mentioned above you have as a coupling the composer's Three Russian Folk Songs with choir, which are also rarely played items.

Another feature of the new disc is that it is not one of Philips' best engineering efforts — an unusual charge to be made against this label. Although I have recently heard or read of de Waart this is, so far as my memory goes, the first of his recordings to come my way. I regret my inability to be more encouraging but can add, for the encouragement of Rachmaninoff collectors, that this is the first recording of the Caprice Bohemien.

★ ★ ★

HAYDN — Trumpet Concerto in E Flat.
TORELLI — Sonata a cinque No 7 in D.
VIVANI — Two Sonatas for Trumpet and Continuo in C.
TELEMANN — Concerto in D.
FRANCESCHINI — Concerto in D for Two Trumpets. EMI Stereo OASD2938.

The words "Haydn Trumpet Concerto" are in such big type on the sleeve of this excellent disc that one might well overlook works, in much smaller type, by Telemann, Franceschini, Torelli and Vivani. If for this reason you are put off from buying you will miss some delectable playing, both by the soloist, John Wilbraham, and the Academy of St Martin-in-the-Field under its regular conductor, Neville Marriner.

To record a trumpet against a chamber orchestra and preserve a reasonably satisfactory balance requires very great judgement indeed. Yet it comes off splendidly on this disc because the trumpet never blares. The never-too-demanding tempos also help to establish an atmosphere of real chamber music. But does one ever expect less from this splendid group? I cannot recall a single performance of theirs which disappointed me. And in this new release they are again at the top of their form exhibiting all the refinements one expects from them.

The engineering is so good that one or two spots in which the balance goes ever so slightly awry would have passed unnoticed in a less-sensitive recording. A word of praise, too, for Christopher Hogwood who plays the harpsichord and Kenneth Heath, the cello, both of whom also have their moments of glory.

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Variety Fare

Reviews of other recordings

Devotional Records

TEN FAVOURITES. George Beverly Shea. Stereo, RCA APL1-0358.

It's some time since I have reviewed an album by Billy Graham crusade soloist Bev Shea. Recorded at RCA's Nashville studios, with backing by the Jordonaires and orchestra, it's an album that will appeal to Bev Shea's many fans. In his jacket notes, well known guitarist Chet Atkins pays tribute to the dedication and care that his friend put into the preparation of the album. The ten favourites include:

The King Is Coming — Acres Of Diamonds — Wings Of A Dove — I'd Rather Have Jesus — Standing In The Need Of Prayer — There's Something About That Name — Amazing Grace — Shall We Gather At The River — He Touched Me — How Great Thou Art.

Technically, the quality of the disc is well up to standard and, if you have a matrix quadraphonic set-up, it spreads nicely in four channel. As one who has been aware of Bev Shea's vocal testimony from his early days on television and films, I enjoyed this latest album. Recommended. (W.N.W.)

★ ★ ★

THE GREAT WELSH HERITAGE. Cymanfa Ganu Underbol Treorici A Cylch. Stereo, Decca SKLA-7706.

I have reviewed many albums of Welsh choirs but none as Welsh as this. It opens with a prayer in which the only word I recognised was "Amen". Then follow sixteen hymns, most of them identified by their Welsh titles. Here they are, for the sake of those who can read them: Sarah — Arwelfa — Innocence — Prysgol — Builth — Garnlwyd — Blaen-Y-Coed — Worthy Is The Lamb — Bryn Myrddin — Troyte's Chant — Gwynfa — Y Faenol — Brwynog — Trewen — Pennant — Cwm Rhonda.

If your knowledge of the language is adequate, there are a further two columns of jacket notes in fine print. Mercifully, there are two more columns in English tracing the history of the valleys, the mines, and the deeply religious community spirit which centred on the many non-conformist chapels.

Recorded in the Noddfa Chapel in North Wales, the 200-voice choir is directed by Terry James, with organist Richard Elfyn Jones. I didn't time it but the album played for best part of an hour — a rather long session of disciplined but otherwise straight congregational style singing. One side at a sitting would be enough for any but the most avid enthusiast!

The program concludes with a benediction and, again, that one recognisable word "Amen".

The sound and general balance is good and, thanks to a bit of 4-channel synthesis, I was in the middle of the choir. If you have a Welsh background, this would be a real bonus album. For more ordinary mortals, I would suggest any one of a variety of alternative albums with Welsh choirs singing more familiar items. (W.N.W.)

★ ★ ★

NOSTALGIA. Timeless Hymns Arranged by Bill Pursell. The Young Church Singers. Stereo, Word WST-8610-LP from Sacred Productions Aust, 181 Clarence St, Sydney and other capitals).

With a title as above, this album should be predictable but Nashville musician Bill Pursell has done his best to make it otherwise, without alienating those who might opt for a nostalgic album of hymns. The Young Church singers manage to create the atmosphere of a boys' choir, supported at times by weightier voices, but again with a familiar "church" quality. The sound is supported and embellished by strings and gentle rhythm. In fact, it's quite a clever blending of traditional and popular sound. Strangely, "Church In The Wildwood" is the one number which gets an up-tempo treatment but it's still so completely recognisable that Granny will be tapping her stick in the corner!

Other tracks are: In The Garden — The Sweet By And By — Unclouded Day — Only Believe — Rock Of Ages — Beyond The Sunset — No One Ever Cared For Me Like Jesus — Old Rugged Cross — Amazing Grace.

Old hymns can be notable for their tradition and formality. Here they are relaxed and gentle and pleasant listening for that very reason. (W.N.W.)

Instrumental, Vocal and Humour

DAVID OISTRAKH VIOLIN VIRTUOSO. Beethoven Violin Concerto in D, Opus 61. Mendelssohn Violin Concerto in B Minor, Opus 64. Kiril Kondrashin conducting the USSR State Orchestra. Astor Gold stereo AGS 1014.

The sound of this album is very dated even though it has been supposedly "electronically reprocessed" for stereo. To my mind, this processing seldom does much to enhance the sound — it might as well be left as mono. But the two concertos played by David Oistrakh are still beautiful. And that is all that really matters. Surface noise on the album was negligible. (L.D.S.)

THE MAGIC OF THE WALTZ. The London Concert Orchestra conducted by Robert Snell. Sunset Harlequin series L25077 Festival release.

The "Strauss is grouse" brigade will really enjoy this delightful record of waltzes, both traditional and modern. Side one carries: The Blue Danube — The Sleeping Beauty Waltz — Tales From The Vienna Woods — Waltz From Serenade For Strings — Gold And Silver Waltz — The Minute Waltz; side two has the modern offerings such as: By Strauss By Gershwin — Waltz Of My Heart — Fascination — The Anniversary Waltz — Under The Bridges Of Paris — Lover.

The sound is excellent, with the brass having a warm fruitiness about it that tends to conjure up the period very well. At $3.99 it's a steal. (N.J.M.)

★ ★ ★

DANCING IN GERMANY. Hugo Strasser and his Dance Orchestra. Columbia stereo 10102.

An enjoyable album of music in almost, but not, rigid strict tempo dance rhythms. Dance to it if you like but it is also pleasant as background for dining or quiet relaxation. Each track has a particular dance rhythm. Record quality is good.

Tracks are: Tramonte (waltz) — Noches Des Estrelitas (tango) — You're The Cream In My Coffee (quickstep) — April Love (foxtrot) — Ein Sommeraband (waltz) — Silver Boogie — Cumana (samba) — Antonio (cha-cha) — Flamingo (Rhumba) — El Gato Mentes (paso doble) — Mexico Twist (twist) — Timpanola (bossa nova). (L.D.S)

★ ★ ★

20 MEMORABLE HITS From Irving Berlin & Cole Porter. Enoch Light and his Orchestra. Stereo, Command "Two Up" 2-record album RSSD-104-1/2.

How do you like your Irving Berlin and Cole Porter? Tuneful and lush? With emphasis on the lyrics? If you do, you may have reservations about this offering on the Command label. There are lush segments, of course, but Enoch Light is too fond of sonic spectacle to settle for too much of that. You either listen to his arrangements and his instrumentalists, or you turn them off!

There are twenty tracks on the two sides. Amongst the Irving Berlin numbers are: No Business Like Show Business — Always — Cheek To Cheek — Alexander's Ragtime Band — A Pretty Girl Is Like A Melody; and others.

The Cole Porter group includes: Night And Day — Easy To Love — Begin The Beguine — I've Got You Under My Skin — Let's Do It; and so on.

The quality is okay, although I would hesitate to say that it was quite equal to Enoch Light at his considerable best. But your reaction to the set won't depend on that. As I observed earlier, it will depend, really, on how you like your show music. (W.N.W.)

★ ★ ★

MILLION DOLLAR MOTION PICTURE THEMES, Richard Hayman and his orchestra. Musicor L35160 Festival Release.

Ten themes from recent movies make the content of this easy to listen to record, with some imaginative orchestration to lift it out of the "light popular" rut. Richard Hayman is chief arranger for the Boston Pops Orchestra and this shows through in quite a number of ways.

Reviews in this section are by Neville Williams (W.N.W.), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).

VARIETY FARE

The titles include: The Way We Were — Free As The Wind — Last Tango In Paris — Lara's Theme — Ruby — Tubular Bells (from "The Exorcist") — Sadie Thompson's Song — Serpico Theme — Mame — Theme From 2001.

The quality is good, with effective use of the stereo image; ideal as a dining background. (N.J.M.)

★ ★ ★

STAR PROFILE — WILHELM KEMPFF. Stereo, DGG Privilege Series, 2726 022. Two disc set in folding sleeve.

This set shows the renowned German pianist interpreting four of the great composers, arranged in chronological order. Side 1 has Mozart: Sonata in A (the one with the popular Turkish March) — Fantasy in D minor. Side 2 has a performance of Beethoven's "Appassionata" Sonata in F minor. Side 3 presents the four Schubert Impromptus of Op. 90. Side 4 has shorter works of Brahms: 2 Rhapsodies, Op. 79 — 3 Intermezzi, Op. 117 — Capriccio in F minor, Op. 76, No. 1.

This is certainly a most interesting and varied program, and if you are a Kempff admirer you are sure to enjoy it immensely. For my part, I find his approach to some aspects of this program rather too bland and ultra refined. Where, for example, is the "molto passionato" indicated by the composer in the second Brahms Rhapsody; and I prefer rather more fire in the Schubert No. 4 Impromptu. Even so, there is a great deal to admire and enjoy in this long program. Throughout the most difficult parts, Kempff does not sound the least bit extended, his control of the material is complete, and he always wins a beguiling singing tone from his instrument. The recordings date from 1962 to 1966 and, while today's recordings might have slightly more clarity, most people will find the sound quality entirely adequate. (H.A.T.)

BARRY CROCKER & TONY HATCH — SUPERB

BARRY CROCKER. The Tony Hatch Orchestra with the Michael Sammes Singers. Stereo, Astor TVS-1003. (Musicassette CTVS-1003.)

Astor Records are particularly proud of this new Barry Crocker album. Though recorded in the Pye Studios in London, the fact that it features Barry Crocker and is otherwise an Australian production qualifies it as such in the eyes of the Australian Broadcasting Control Board. Technically the record itself is excellent and if there has been a more superbly printed frontispiece to a jacket, I can't recall it!

Barry Crocker himself is in excellent voice, a straight, robust baritone appropriate for the popular show tunes featured.

Here and there you may pick him for being slightly off pitch but don't be too hasty; he slips immediately into such perfect pitch that it is quite evidently a deliberate mannerism. The songs: Corner Of The Sky (Pippin) — If I Ever Should Leave You (Camelot) — Donkey Serenade — Pilate's Dream (Superstar) — Younger Than Springtime (South Pacific) — If I Were A Rich Man — I Have Dreamed (King & I) —

Granada — Be My Love — Girls Were Made To Love And Kiss — Come Prima — Soliloquy (Carousel).

If you like show tunes, Barry Crocker, The Mike Sammes Singers, or Tony Hatch — any or all of them — you'll like this handsome album. It's a good one. (W.N.W.)

PORTRAIT OF EDITH PIAF. Mono, EMI EMC. 2516.

Many of these tracks have already appeared in previous Piaf re-releases, of which there have been many since the singer's death 10 years ago. There are 16 titles: Milord — C'est L'Amour — La Chanson de Catherine — Bravo Pour le Clown — Exodus — Sous le Ciel de Paris — L'Accordeoniste — Hyme a L'Amour — Padam, Padam — Les Mots D'Amour — Mon Dieu — La Vie en Rose — La Goulante de Pauvre Jean — C'est a Hambourg — Cri de Couer — Non, Je ne Regrette Rien. Whether these can all be listed under "16 of her greatest performances" as claimed on the sleeve I leave to you to decide. Certainly some of them are not in dispute.

Piaf fans will vote a special vote of thanks to the engineer who did such an excellent job of remastering. The background noise which we used to accept as inevitable with re-issues of old recordings is virtually non-existent. (H.A.T.)

★ ★ ★

PRESENTING BOTTICELLI AND HIS ORCHESTRA. Decca Phase 4 Stereo PFS-4281.

Though released under the very British Decca Phase-4 label, this particular album was recorded originally in the Dureco Studios in Holland. I mention the fact as a matter of interest but, musically, it could have come from anywhere in the world of popular music. It is tuneful, gently rhythmic, easy on the ear, and familiar: Tie A Yellow Ribbon — My Love — Killing Me Softly With His Song — It Never Rains In Southern California — Day By Day (Godspell) — Mammy Blue — Song Sung Blue — You're So Vain — Never, Never, Never — Looking Through The Eyes Of Love.

The sound is clean and spreads well in either 2-channel as intended, or 4-channel if you play it through a synthesiser. All told, "sweet music" on the brighter side. (W.N.W.)

★ ★ ★

THE KINGS OF THE SPANISH GUITAR. Los Romeros. Stereo, Philips 6780 252. Two disc set in folding sleeve.

This famous group of four flamenco guitarists, spanning three generations, play solos and ensemble, sometimes with contributions by a cante jondo singer. It is all extremely professional, but perhaps a little too slick for the real devotees of flamenco. One is left with the feeling that, for the Romeros, this is more a profession than an art. Still, there is no doubt that it is all very entertaining, and as an example of technical excellence leaves nothing to be desired. The Philips recording is excellent, too, with fine clarity and good stereo. (H.A.T.)

VARIETY FARE

BRIDGE OVER TROUBLED WATER. The Grand Fantastic Strings. Stereo, RCA Camden VCL1-2009.

Singing strings, 101 strings, 1001 strings, fantastic strings, Grand Fantastic Strings: what's the difference? Mainly in the name and the bracket of tunes they elect to play! Which is a roundabout way of saying that this recent Camden release is exactly the kind of record you'd expect: lush, tuneful and sure to please if you have a place in your collection for another album of orchestral strings. The titles:

Yesterday — Michelle — Hey Jude — Let It Be — Long And Winding Road — And I Love Her — Sound Of Silence — El Condor Paso — Mrs Robinson — Scarborough Fair Canticle — Boxer — Bridge Over Troubled Water.

The surface is clean, the sound well balanced and I doubt that you'll hear a distorted note anywhere. Good for background, spreads well in stereo, better again in 4-channel. (W.N.W.)

★ ★ ★

GLENN MILLER plays selections from "The Glenn Miller Story". RCA Camden VCLI-2004 Stereo.

If you're a Glenn Miller fan and have been nursing your old 78's, this record could give them a reprieve. But don't expect any improvement in quality, as the tracks betray their age in no uncertain manner.

The twelve tracks are: Moonlight Serenade — American Patrol — Pennsylvania Six-Five Thousand — In The Mood — I've Got A Gal In Kalamazoo — Boulder Buff — Tuxedo Junction — St Louis Blues — String Of Pearls — Little Brown Jug — Farewell Blues — King Porter Stomp.

If you can overlook the quality, this record will give you the most representative collection of Miller's work you could ask for. (N.J.M.)

★ ★ ★

BIG HIT INSTRUMENTALS. Various orchestras. Karussell stereo 2495 058.

Here is a great record for showing off your hifi system. Even it is a crummy system it will still sound spectacular with this record. We bet that this record will become the standard demo record for salesmen in the electrical section of all the big department stores. It has all the "big-sounding" German bands such as Bert Kaemfert, James Last, Roberto Delgado, Kai Warner and Peter Thomas.

If you have a good sound system, you will realise that recording quality is good. If not, who cares? It makes good buying at the economy Karussell price.

Track titles are: Spanish Eyes — A Man And A Woman — Guantanamera — Mexico — Love Is Blue — Mr Sandman — Games That Lovers Play — Georgy Girl — Capri Serenade — Strangers In The Night — La Bamba — Lara's Theme. (L.D.S.)

★ ★ ★

STRAUSS FAVOURITES. Boston Pops Orchestra, conducted by Arthur Fiedler. Stereo, RCA Camden ACL1-0434.

There might be justification for resurrecting old recordings made by famous artists of the past, retired or dead, but I can see no point in this disc of very old tracks, dating from 1939 to 1945, by an orchestra and conductor still actively recording. Not only that, there are numerous excellent discs of Strauss's music of recent vintage by Viennese groups which most people still prefer for Strauss performances. To cap it all, there is only about 30 minutes of playing time offered here, whereas some discs offer more than 45 minutes. Just in case you are interested, the titles include Roses of the South — Tritsch Tratsch Polka — Dichterliebe Waltz — Cagliostro Waltz — Pizzicato Polka. The sound is what you would expect from 30 year old recordings. (H.A.T.)

★ ★ ★

THE HITS OF CAT STEVENS. George Harrison & Elton John. The Mike Batt Orchestra records this L 45421/2 Festival Release.

Twenty nine numbers from three of the best known talents on the music scene for the two-record set price of $7.95 sounds good value, but there is a let-down in the quality department, with an edginess to most of the tracks.

This was so noticeable that I played the records on a no-expense-spared outfit belonging to a friend to rule out any malfunction in my own gear. I hope it was only on the review copy!

Among the titles: Bluejay Way — Here Comes The Sun — My Sweet Lord — If I Need Someone — Morning Has Broken — Portobello Road — I Love My Dog — Wild World — Moon Shadow — Border Song — Country Comfort — Your Song — Lady Samantha. (N.J.M.)

VARIETY FARE

TAMBU. Charlie Byrd and Cal Tjader. Fantasy stereo L35205. Distributed by Festival Records Pty Ltd.

Charlie Byrd on guitar and Cal Tjader on Vibraphones get together here for a session that they obviously enjoyed along with the rest of the musicians featured. But it seemed to me that once they got into a particular groove they could not get out of it — which made some tracks pretty monotonous. More variations please! Record quality was up to standard and surface noise was low.

Tracks are: Tambu — Terza My Love — Black Narcissus — Sad Eyes — My Cherie Amour — San Francisco — Samba De Oneida — Don't Lend Your Guitar To Anyone. (L.D.S.)

★ ★ ★

NEIL DIAMOND. HIS 12 GREATEST HITS, MCA stereo MAPS 7400.

If you are a keen fan of Neil Diamond but do not have one of his records, here is a good buy with 12 of his most popular hits. Quality is good and the arrangements are exactly as on his original hit releases.

The twelve titles are: Sweet Caroline — Brother Loves Travelling Salvation Show — Shilo — Holly Holy — Brooklyn Roads — Cracklin' Rosie — Play Me — Done Too Soon — Stones — Song Sung Blue — Soolaimon — I Am I Said. (L.D.S.)

★ ★ ★

ISKYBIBBLE, Vol 2. Dumonde Records L15267. Festival Release.

Something different from the usual run of children's records can be a pleasant change and this particular disc carries on one side a gentle reminder about pollution, particularly that of the oceans. The reverse has a story concerned with honesty with one-self and a regard for all of creation. The musical content is bright and happy, in all a good disc for that problem birthday present. The quality is excellent. (N.J.M.)

A DATE WITH FLOYD CRAMER. RCA Camden CXS -9016 Stereo.

In this two-record set by "Nashville" pianist Floyd Cramer, we get eighteen all-time hits like: Almost Persuaded — King Of The Road — Night Train — Chattanooga Choo Choo — Half As Much — Don't Get Around Much Anymore — Tuxedo Junction — Canadian Sunset — Born Free — A Taste Of Honey — Woodchopper's Ball — Naomi.

The piano certainly dominates with almost a boogie beat on some tracks but the unnamed orchestra and wordless chorus help to give a good all-round sound with good quality. (N.J.M.)

★ ★ ★

IT'S GOOD TO BE ME. Tony Christie. MCA stereo MAPS 7256.

I guess Tony Christie has every reason to feel good after doing what he did to Maria. Er um. Anyhow this record is more of the same style with some well-known and some not-so-well-known songs. Recording quality is okay but nothing to rave about. Surface noise was noticeable on some tracks on my system.

Track titles are: If It Feels Good — Do It — Sittin' On The Dock Of The Bay — Love And Rainy Weather — Tie A Yellow Ribbon — The Janes, The Jeans And The Might-Have-Beens — It's Good To Be Me — I'm Gonna Make You Love Me — You And I — If You Stay Too Long In Oklahoma — Baby I'm A Want You — A Year And A Wife And A Kid Ago — Here's That Rainy Day. (L.D.S.)

★ ★ ★

LENNY DEE. Stereo, Astor MAPS-7173.

Seeing the name Lenny Dee, one naturally expects an organ recording but right through the first track there is the suspicion that the labels have been transposed! The sound is primarily orchestral with the organ so disguised and so modified by waa-waa — that it could be something altogether different. Track 2 reveals the organ in a percussive voice and track 3 continues its emancipation. By track 4 it's firmly entrenched!

As you might gather from this, Lenny Dee's "thing" is to feature the organ as part of an orchestra and this he does very well indeed, obviously with the help of an unspecified but versatile instrument.

The tracks: The Most Beautiful Girl — Paper Roses — Behind Closed Doors — Rhapsody In Blue — Why Me — Top Of The World — Leave Me Alone — Time In A Bottle — Until You Came Back To Me — Satin Sheets — You're Sixteen, You're Beautiful.

The tunes are well arranged and bright and the sound is very clean. In fact, It's very easy on the ear. Well worth a hearing. (W.N.W.)

★ ★ ★

THE DUTCH SWING COLLEGE BAND. Meets Joe Venuti. Parlophone stereo PCSO 7159.

Swing is the operative word when describing the world famous Dutch Swing College Band. And they really do when they get together with Joe Venuti who, now well into his seventies, is the most outstanding jazz violinist ever known. Listening to them belt through such old-timers as "Raggin' The Scale" one has to admit that the oldies (like Venuti) really have drive.

Only one side features Joe Venuti but the whole album is good listening. And recording quality is good throughout.

Other tracks are: Wild Dog — Body And Soul — Wild Cat — Blues In C — I Got Rhythm — Duff Campbell's Revenge — I Remember Johnny — Stealing Apples — Black And Blue — Royal Garden Blues. (L.D.S.)

★ ★ ★

PLEIN SOLEIL, SCREEN MOOD. Grand Fantastic Strings RCA Camden VCL I-17008.

A pleasant listening dozen of movie themes is the offering on this release on the RCA budget Camden label. I've never heard of the orchestra before, but they do an excellent job of such favourites as: Love Theme From 'The Godfather' — Love Is A Many Splendored Thing — East Of Eden — Fascination — Johnny Guitar — Last Tango In Paris — Melody Fair — Brother Sun Sister Moon — Il Ferroviere — The Umbrellas Of Cherbourg — Romance D'amour — Plein Soleil.

Quality and stereo image are good; in all an ideal disc for that quiet evening at home. (N.J.M.)

COUNTRY BOOTS, Boots Randolph Monument Records L35161 Stereo Festival Records Release.

Saxophone player Boots Randolph is in excellent form in this collection of country flavour hits, including: Wabash Cannon Ball — Tennessee Waltz — Take Me Home Country Roads — Jambalya — Behind Closed Doors — Wildwood Flower.

Some of the backing musicians are Floyd Cramer on piano, Grady Martin on guitar, Bobby Thomson on banjo, Bob Moore on bass, Buddy Harmon on drums and Farrell Morris on percussion. With excellent quality it is a most enjoyable record. (N.J.M.)

THE WORLD OF PETE AND DUD. Peter Cook and Dudley Moore. Decca PA 311.

As a keen fan of Peter Cook and Dudley Moore, the English comedy duo, I was pleased to obtain this record. While it lacks some of the impact of their live performances, it leaves you with time to admire the cleverness of their rapier wit. I thoroughly enjoyed it.

The tracks are titled as follows: Art Gallery — A Bit Of A Chat — Lengths — The Psychiatrist — Dud Dreams — The Ravens — Father And Son — Six Of The Best. (L.D.S.)

★ ★ ★

SINGALONGAMEMORY Max Bygraves Astor SPLP 1428 Stereo.

Max Bygraves is always easy to listen to and enjoy and this medley of twenty-eight old favourite melodies is no exception. It would be a great starter for a party sing-along.

Some of the titles included are: Memories — I Love You Truly — Home On The Range — The Last Round-Up — Making Whoopee — On A Slow Boat To China — Somebody Stole My Gal — Sonny Boy — Red Roses For A Blue Lady — Shine On Harvest Moon — As Time Goes By — The Happy Wanderer — Ferryboat Serenade.

The quality is good, with a good backing from orchestra and vocal group. (N.J.M.)

Product reviews & releases

Dual-channel CRO has LED readout

Using the microprocessor from the familiar HP-35 Calculator, this new dual-channel 275MHz oscilloscope, the Model 1722A from Hewlett Packard, provides integrated digital LED readout of time interval, frequency, DC voltage, instantaneous voltage, and percent differences between amplitudes.

Recently released by Hewlett-Packard is the Model 1722A Oscilloscope, probably the first oscilloscope on the Australian market to provide true digital readout of time interval, frequency, DC voltage etc. Incorporating the LSI digital microprocessor chip from the now famous HP-35 calculator, the new instrument is claimed to give improved accuracy, greater measuring speed, and greater convenience.

Following the release of the new oscilloscope and several related instruments, a series of seminars was presented in both Melbourne and Sydney by Mr Jeff Duer of Hewlett-Packard's oscilloscope plant in Colorado Springs, Colorado. These seminars, held towards the end of October, covered the applications of new and existing oscilloscopes, interpretation of specifications, logic analysis using a digital oscilloscope display and data error analysis.

The 1722A is based on the familiar HP Model 1720A Oscilloscope, and retains all its performance characteristics. These include full 275MHz bandwidth in both 50-ohm and 1-megohm input modes over the full 6 x 10cm display area in both vernier and calibrated settings.

Vertical deflection factors are 10mV/div to 5mV/div over the full 275MHz band, with 2pc attenuator accuracy. The 50-ohm input is internally compensated for faithful pulse reproduction and accurate transition time measurements. Stable internal triggering to 300MHz requires only 1cm of deflection. Because the trigger sync take-off is just after the attenuator, the display remains stable regardless of changes in position, vernier, or polarity controls.

Measurements such as clock phase, risetime, pulse width, period, or propagation delay can be made with resolution as great as 20px. Using an exclusive new HP technique known as dual delayed sweep, both the start and stop points of a time interval measurement can be displayed as intensified markers on the screen. The interval, thus precisely defined, is then calculated by the microprocessor and digitally displayed on the LED readout.

For maximum possible accuracy, the start and stop points on the trace, displayed alternately, may be overlapped. The digital readout eliminates the counting of lines, mental multiplication of dial settings, and interpolation. Desired time intervals can be preset into the LED readout, enabling the circuit under test to be adjusted to give the same reading.

When the 1722A is set to the 1/TIME mode, the microprocessor computes the reciprocal of whatever was set in the TIME mode, and displays this answer on the LEDs. In this manner, the display can be used to provide a direct readout of frequency. As with time interval settings, the frequency may be preset, and the circuit under test adjusted to match.

The 1722A may be set so that the LED readout will digitally indicate the average (DC) voltage at the input of Channel A. It then functions as an autoscaling 3½-digit DVM. The display can be compensated if a 10:1 divider probe is used.

There is also a POSITION mode with which the amplitude of any point on the display may be measured, either relatively or absolutely, thus giving instantaneous voltage levels. A reference level may be established and any other displayed level then compared with it, allowing the unit to function as a differential voltmeter. And there is the simple technique by which the percentage difference between any two amplitudes on the screen may be calculated and displayed. Percentage difference may also be preset.

The price of the instrument is $3,600 duty free, far below that of other oscilloscopes or combinations of instruments approaching its measuring capabilities.

For further information contact Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Vic 3130. Telephone 896351. Branches also in Adelaide, Brisbane, Canberra, Perth, and Sydney.

Range of compact power transformers

Ferguson Transformers has announced that its smallest transformer capable of operating off the 240V 50Hz mains, the PF2851, has been redesigned to meet the requirements of Australian Standard C126. In addition, two new transformers, the PF3786 and the PF3787, have been added to the range, and together these are designed to meet the low power, small size requirements of the Australian electronics industry.

The three transformers have two identical secondary windings which may be either series or parallel connected. The choice of voltages is 6, 12, 14, 18, 28 and 36V at approximately 2.5VA, with no load voltages of the order of 25pc above these values.

Further enquiries should be directed to Ferguson Transformers Pty Ltd, PO Box 301, Chatswood, NSW 2067.

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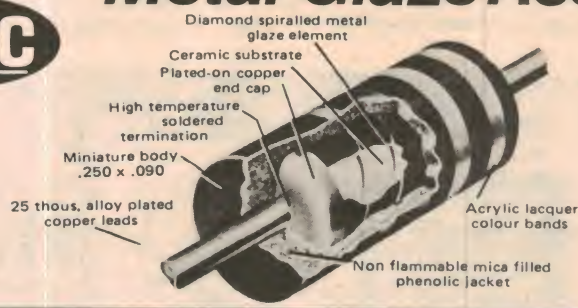

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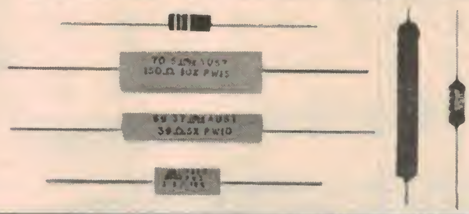

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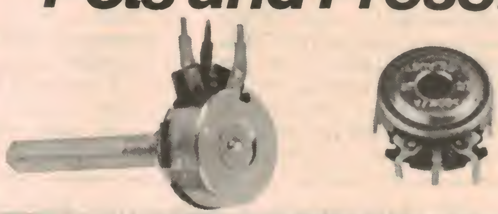

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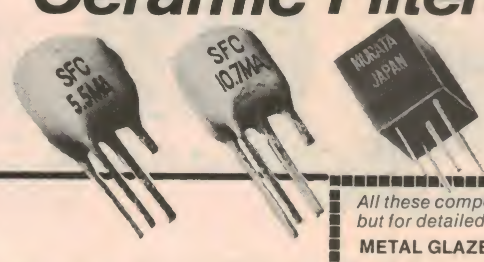

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NEW PRODUCTS

Compact supply from A & R Soanar

The range of power supplies from A & R Soanar has been expanded with the release of the model PS205, a very compact unit with an output of 2-15V DC at up to 500mA.

Housed in the plastic 142 x 80 x 71mm case used for other supplies in the A & R Soanar range, the PS205 is compact. It is also light in weight, only 1.25kg. And as you can see from the photograph, it is attractively styled. The single meter is switched to read either 0-20V or 0-500mA.

Output voltage is continuously adjustable from 2 to 15V, and the output is floating. Either output terminal may be earthed, or the whole output circuit floated at up to 200V DC above ground. Among other things this makes possible series or parallel operation of multiple units.

Internally the PS205 is fairly straightforward, with a 2N3055 series pass transistor driven by a 723 op amp. Output current limiting is fixed at approximately 630mA, to protect the supply against shorts, etc.

Load regulation is rated at better than 15mV change for full load change, with line voltage regulation less than 2mV change for plus and minus 10pc input change. Ripple and noise are less than 5mV peak to peak.

In short, the performance of the PS205 should make it quite suitable for servicing, development and educational applications.

Price of the PS205 is quoted as $78 plus sales tax where applicable.

Enquiries may be directed to A & R Soanar Electronics at 30 Lexton Road, Box Hill, Vic, or 4 Close St, Canterbury, or from normal trade suppliers.

Cordless soldering iron

Dick Smith Electronics are now marketing a cordless soldering iron which should find many applications.

Made by leading US manufacturer Wall-Lenk, the iron uses a single nickel cadmium cell which is built into the handle. A pressbutton switch is used, with the tip heating to 700F in about 5 seconds. A built-in lamp also lights the work area. Up to 120 joints typically can be made from a single charge.

The iron is only 20cm long, and is light in weight. This plus its independence from the power mains should make it particularly popular with service technicians. Other obvious applications would be for field work on cars, boats, caravans, etc.

It would also be ideal for development work on modern IC circuitry, especially CMOS, which can easily be damaged by leakage currents from conventional irons.

The Wall-Lenk BP100 sells for $19.95 including tip. A 240V charger is available at $10. A simple kit for a charger to operate from a vehicle battery is also available, at a cost of 50c. Spare element tips and NiCad cells are also available. The iron is fully guaranteed for 90 days.

Further information from Dick Smith Electronics Pty Ltd, 160-162 Pacific Highway, Gore Hill 2065.

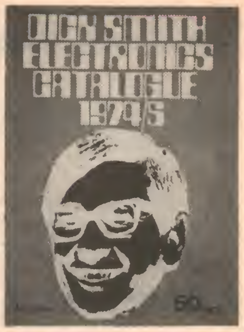
Cases from Celotek Industries

Pictured are samples from the range of standard instrument and utility cases for both amateur and professional electronic applications made by Celotek Industries Pty Ltd. Apart from standard cases and rack hardware, this firm is also in a position to make special metalwork to order, through normal trade suppliers. This includes "EA" project metalwork.

An illustrated brochure of standard cases is available at 40c to cover post and handling. Enquiries to Celotek Industries Pty Ltd, 5 Greenfield St, Botany 2019.

NEW PRODUCTS

New catalogue, low cost transformers from DSE



A new electronic component and equipment catalogue for 1974/75 has recently been published by Dick Smith Electronics Pty Ltd. In addition, Dick is also offering a new range of specially imported transformers at prices approximately half the cost of currently available equivalent transformers. These new transformers are available to component stockists, and trade enquiries are invited.

Containing some 64 pages, the new catalogue provides the latest information on electronic components, projects, kits, test equipment, tools, servicing aids and accessories. In particular, the amateur equipment and publications sections of the catalogue have been extended. A copy of the catalogue is available for 50c post paid from Dick Smith Electronics, 160-162 Pacific Highway, Gore Hill, NSW 2065.

The new range of transformers has been specially designed for Australian conditions to exceed dielectric test requirements of Australian standard C126. Designated types

DSE2851, DSE2155 and DSE6672, they sell for $3.50, $4.75 and $6.50 respectively. Ratings of the new transformers are as follows:

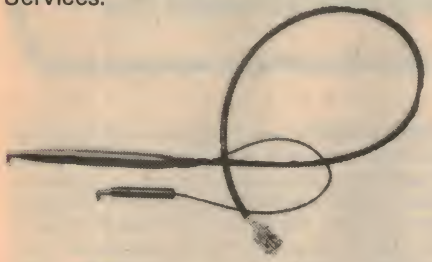
- DSE2851 — 12.6V centre tapped secondary rated at 150ma;
- DSE2155 — tapped secondary giving 6.3, 7.5, 8.5, 9.5, 12.6 and 15V at 1A;
- DSE6672 — tapped secondary giving 15, 17.5, 20, 24, 27.5, and 30V at 1A.

All three transformers have 240V AC primary windings, the DSE2851 having flying lead terminations, the other two type numbers having solder tag terminations. The new range is available from several component stockists in addition to the Dick Smith Electronics Centres, and trade enquiries are invited. Minimum trade order value is $100.00.

Further enquiries on the new transformer range should be directed to Dick Smith Electronics Pty Ltd at the abovementioned address.

Low cost kits for scope probes

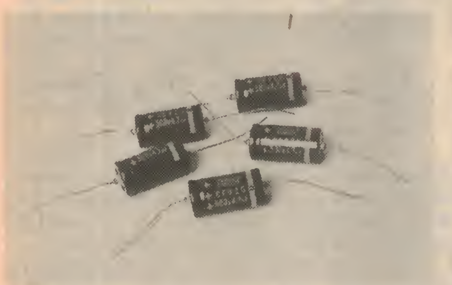
A low cost scope probe and cable kit from the E-Z-Hook people is now available from General Electronic Services.



If you've ever bought a high-quality probe for a measuring scope, you'll know they don't come cheaply. And making your own isn't easy, as good probe cases are hard to find. These new kits from E-Z-Hook are designed to solve both problems. You can buy either a complete assembly, fitted with cable and suitable connector (BNC, UHF or banana plugs), or just the probe case itself. This is a high quality unit which screws together, has an internal tagstrip for probe wiring, and provides for either tip contact or clip-on contact.

The prices are very attractive: $7.80 plus tax for a complete kit, $1.30 plus tax for a probe case. From General Electronic Services, 99 Alexander Steet, Crows Next 2065.

Flash capacitors



Readers wishing to construct the High Efficiency Flasher of August 1971 (File No. 3/MS/27) have been concerned that the electrolytic dump capacitor which was specified in the article — Ducon 4.7uF, 500VW, type ETW7B — is no longer available. As we were careful to point out in the article, it is not advisable to substitute a capacitor in this role simply on the basis of its capacitance and voltage rating. The high internal impedance and relatively high leakage of the conventional filter type capacitors makes them unreliable in this role.

At our suggestion, Allied Capacitors Pty Ltd, selected a small batch of capacitors from their Nippon Chemi-Con range and subjected them to the same tests as normally used for photo flash capacitors. As a result of these tests they feel confident that this unit can safely be used in the High Efficiency Flasher. The capacitor to specify is the CEO2D, 4.7uF, 500V. Further details from Allied Capacitors Pty Ltd, P.O. Box 198, Brookvale NSW 2100.

Books & Literature

Colour TV manual

PAL COLOUR TELEVISION FOR SERVICEMEN, by W. C. Cook. Published by Wren Publishing Pty Ltd, 33 Lonsdale St, Melbourne, 1974. Hard cover, 140 x 220mm, 248pp, numerous diagrams, many in colour. Price $15.

As the publishers point out, this is the first manual to be published based on the Australasian (Australia and New Zealand) PAL colour system. As such it undoubtedly fills a long-felt want in this part of the world.

According to the author, the book is aimed primarily at the student and serviceman, with the assumption that both are already well versed in monochrome TV.

The list of chapter headings gives some idea of how the subject is dealt with:

1 Monochrome Transmission and Picture Composition
2 Colour Theory
3 Chrominance Signal
4 Colour Transmitter Encoder
5 NTSC Receiver, Monochrome Section
6 NTSC Receiver, Chrominance Section
7 PAL Colour Television System
8 Receiver Installation
9 Test Equipment
10 Servicing and Circuit Analysis

There is a glossary of technical terms at the front of the book, and in addition nine data appendices at the rear.

The chapter on colour theory contains several colour plates including the classic CIE chromaticity diagram, or colour triangle. In it the author explains additive and subtractive colour mixing, and gives precise figures by which the additive primaries as used in the Australian PAL system are defined. In view of this it is rather a pity that his definition of subtractive mixing is rather sketchy and falls into the classic trap of suggesting red, yellow and blue as the subtractive primaries.

The chapter on colour transmission encoding is most comprehensive and, while some servicemen may feel that it is of limited practical value, the student should find it invaluable.

In his chapters on the behaviour of colour receivers he employs a rather novel approach; a description of a mythical NTSC receiver made to Australasian standards. Only when the whole of the operation of this receiver has been covered, and some 80 pages later, does he introduce the PAL principle. While novel, the approach undoubtedly has a number of advantages, the most obvious one being that it allows the PAL concept to be dealt with in considerable detail.

The chapter on convergence and convergence circuitry is also comprehensive, and one which the practical serviceman should find most valuable. It sets out the whole adjustment procedure in considerable detail and, while individual manufacturers may suggest variations to suit their own sets, the basic understanding it provides is essential. The only criticism is that it deals exclusively with the triad type picture tube. There is a brief description of the Trinitron tube, but no details of convergence circuitry or convergence adjustment for vertical aperture tubes in general.

One disappointment is the chapter on power supplies. It makes no mention of the high frequency conversion type supplies which seem to have been almost universally adopted by Australian manufacturers. In a book prepared specially for the Australian scene, this would seem to be an unfortunate omission.

Against this the chapters on installation, test equipment, and servicing adopt an essentially practical approach which the serviceman, in particular, should appreciate.

Criticisms aside, this appears to be a book of considerable merit. It would be a valuable addition to the library of anyone interested in the technicalities of colour TV. Our copy from the publishers. (P.G.W.)

Vintage radio

VINTAGE RADIO, 2nd edition, revised, edited and expanded by Morgan E. McMahon. Published by Vintage Radio, Palos Verdes, California, 1973. Soft covers, 133 x 210mm, 263pp, profusely illustrated. Price in Australia $5.75 plus 50c post & Packing.

A recently released update of Harold Greenwood's classic US illustrated Album of Wireless and Radio, now available to local enthusiasts thanks to the importing initiative of the redoubtable Dick Smith.

If you're inclined towards the nostalgic, I think you'll find it irresistible. Although primarily concerned with vintage radio and electronics in the US, it captures so much of the atmosphere and feeling of the early days that this hardly matters. The equipment was much the same here, even though it had some different names on the front and crackled forth the voices of the "Hullo Man", Jack Lumsdaine, and various local "aunties" rather than Will Rogers or Amos 'n Andy.

It's mainly a picture album, so there's loads of illustrations. Pictures of sets, transmitters, components and pioneers, as well as reproductions of magazine covers, illustrations and advertising. Even a few hoary old jokes — one which took my relatively "modern" fancy was the Scottish set buyer who reported back to the dealer that "the music is fine, but the wee little light is too dim to read by"!

If you're an old timer, or a youngie who is interested in the way it was, this is one I would heartily recommend. And it's very good value at the price asked.

The review copy came from Dick Smith

Electronics, of 162 Pacific Highway, Gore Hill, NSW 2065. Dick tells me they keep large quantities in stock, but they go like hot cakes. If you want a copy, it might pay to be quick! (J.R.)

The third "R"

ENGINEERING MATHEMATICS 2, by Ian D. Cochrane. Published by McGraw-Hill Book Co, Sydney, 1973. Soft covers, 153 x 228mm, 248pp, diagrams. Price not supplied.

The second and concluding volume of this course text, written for current syllabi in mechanical and electrical engineering courses at local technical colleges. The author is a teacher in engineering mathematics at North Sydney Technical College.

Although written primarily as a course text, it is written in clear language and progresses through the subject in a smooth and logical manner. It may therefore be of interest to old-timers seeking a way of "brushing-up", as well as to enthusiasts and amateurs as a text for private study.

The review copy came direct from the local office of the publisher, but copies would no doubt be available from most large and technical bookstores. (J.R.)

Lab manual

ELECTRICAL TECHNOLOGY Laboratory Manual, by M. Court. Published by John Wiley & Sons Australasia, Sydney, 1974. Card covers, 173 x 240mm, 219pp, many diagrams. Price in Australia $3.95.

A laboratory manual written to serve the requirements of first year students in electrical engineering at certificate or technician level. The author is apparently a teacher at the St. George Technical College in Sydney, and has no doubt structured it with the specific requirements of local colleges in mind.

The book is divided into two parts, the first being a guide to help students in carrying out laboratory work and writing reports. The second part then deals with the sequence of 40 specific tests. It would appear to be well written and prepared, but of little if any interest to other than technical college students.

The review copy came from the publisher, but copies would no doubt be in stock at technical and college bookstores. (J.R.)

Servicing guide

GUIDE TO SERVICING TRANSISTORISED EQUIPMENT, Published by the Amalgamated Wireless Valve Company Pty Ltd. Four page brochure, free on application.

This handy little guide for servicemen, amateurs and experimenters does not seek to give a complete course in servicing transistorised equipment, but concentrates on one specific aspect: transistor identification and replacement. As this is probably the aspect which gives most trouble for people, especially those without much experience, it should therefore be found of considerable value. The author is W. R. Eason, an experienced AWV engineer and technical author.

He deals with most aspects of selecting a replacement device for a faulty bipolar transistor, including a guide to fT range, and provides a handy sequence chart to assist the reader in memorising the procedure involved. Copies of the brochure are available free on application to the AWV Company at PO Box 24, Ashfield, NSW 2131. (J.R.)

Basic reference

ELECTROTECHNOLOGY, by M. G. Say, 3rd Edition. Published by Butterworth & Co (Newnes imprint), London, 1974. Hard covers, 143 x 222mm, 176 pp, many circuits and diagrams. Price in Australia $4.50.

The third edition of this useful reference book for engineers, technicians and students. Those who have been in the field some time will probably remember that the first edition was published by George Newnes Ltd back in 1947.

The present edition starts with a thorough exposition of the basic, supplementary and derived SI measurement units, and the physical phenomena on which they are based. It then leads on to discuss the basic electrical and magnetic properties arising from the subatomic structure of matter, and thence to the field concepts applying to media in bulk.

From here the author progresses to the main part of the book, which works steadily and concisely through electrical network analysis. Finally there is a section dealing with special analysis thechniques such as network topology, two-ports, system functions and nonlinearity.

The text throughout is highly concise, as the book has been written to serve mainly as a reference work rather than a first text. However the concepts are presents with commendable clarity, terms are explicitly defined wherever they are introduced, and the text is well served by illustrations.

The review copy came from the local office of the publisher. (J.R.)

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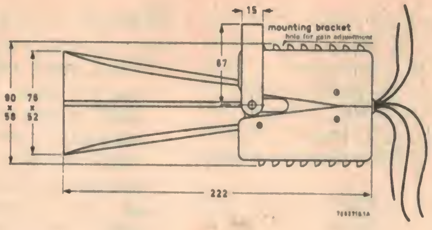

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The Amateur Bands

by Pierce Healy, VK2APQ

WICEN — A community service

Throughout the world amateur radio organisations have, in times of civil emergencies, provided an essential service. In Australia, the Wireless Institute of Australia Civil Emergency Network has an outstanding record.

About 20 years ago Australian amateurs were co-ordinated under the title WICEN as a community service in times of emergency. Since then there have been many instances where initial and sometimes continuous communication links have been provided by amateurs. Notable instances have been the Victorian and Tasmanian bushfires, floods and cyclones in Queensland and New South Wales, fires in South Australia, and cyclones in Western Australia. The latest was the severe floods in Wagga Wagga, NSW.

Recent warnings state that 1974-75 could be a period of extreme bushfire danger. Heeding this, there have been moves to ensure that WICEN is ready if called upon. In some cases reorganisation has been necessary to meet changing conditions and to tie in more closely with other emergency services.

In the past many amateurs joined national emergency organisations as communication officers. In some cases they belonged to their local community body as well as WICEN.

There has been and will be instances when, due to the nature of the emergency, WICEN will not be called upon. But amateurs may still assist by offering their services to local council organisations.

Many local bodies are in real need of experienced operators to man their communication centres.

Recently, Mr Howard Freemen, VK2NL, New South Wales Bushfire Council's communication officer, gave a talk to the NSW Division, WIA, on the Bushfire Brigade organisation in NSW. The following points from the talk will give some idea of the communication side of the organisation. It may also be food for thought for amateurs willing to use their knowledge and experience to assist such organisations.

Each Shire or Municipal council is responsible for the suppression and containment of fires in their area except for portions of that area that are constituted under the Fire Brigade Act (1909-1949).

Throughout the state a statutory bushfire danger period is in force from 1st October to 31st March the following year. A local government council may declare a danger period between the 1st April and 30th September if they consider a danger exists.

There are 2500 Bush Fire Brigades, with a membership of 65000 volunteers in NSW. All are unpaid volunteers, on call 24 hours a day every day of the year.

The brigades are equipped with modern fire fighting appliances and radio communication systems.

Until recently all bushfire radio systems operated in the 2MHz to 3.2MHz band using AM. A re-equipment program, still uncompleted, has replaced approximately two thirds of the HF AM units with modern VHF high and low band FM units. To date there are 83 VHF and 40 HF AM bushfire networks, the latter in the western areas where the distances involved exceed the range of VHF.

VHF FM systems will continue to be introduced where they will provide the coverage. Where VHF is financially and technically impracticable the Bushfire Council will consider an SSB system.

A typical VHF FM system consists of a 50 watt base station with a ground plane antenna controlled, invariably, from the local shire or municipal council office.

Mobile equipment is a VHF 25W transceiver with a quarter wave whip aerial. 27MHz handphone transceivers are used for short-range communications, such as hose line control and communication along and across a fire front.

The main problem that limits the effectiveness of the system is the lack of brigade training in the use and care of radio equipment.

The Bushfire Council conduct annual week long radio schools, but many factors limit the number of volunteers who can attend.

There is a continual need for experienced base station operators in every bushfire brigade organisation.

Any licensed amateur who is interested in volunteering his services as a bushfire base operator and possibly to assist with practical training and advice will be most welcome. He is requested to contact his local town or shire clerk.

If it is not possible to make a local contact, Howard Freeman, will advise whom to contact. Write to — the Secretary, NSW Bushfire Council, (attention communications officer), Box 30, GPO Sydney 2001 or telephone Sydney 20529 extension 318.

THE WAGGA WAGGA FLOODS

Typical of the emergencies for which WICEN was created were the serious floods which ravaged the city of Wagga Wagga in southern NSW during late August and early September 1974. The Wagga District Radio Club played a vital communications role during this period. President of the Club, Harry Hendriks, VK2-ZHX, sent this report.

The Murrumbidgee River twice rose to serious flood level during late August and early September. On Thursday 29th August the mammoth task of evacuating almost the entire population of North Wagga was commenced. It was envisaged that a severe flood would hit the city within 24 hours. The calculated river height was just under 10 metres. At this height North Wagga would be covered to a depth of at least one metre. However, due to continued heavy discharge from the Burrinjuck Dam, plus continued increase in local rainfall, it was realised by the city authorities early on Friday 30th August, that the river would reach an all time record of over 11 metres. The peak was reached late Friday night, at 11.4 metres, the highest reading for over 100 years.

The Wagga District Radio Club was initially requested by the Civil Defence authority to be on "stand-by" as a back-up for the SSB HF and 27MHz systems. As early as Thursday night 29th August it was obvious that the Civil Defence systems would not be satisfactory for "short haul" work. Long skip was producing a great deal of hetrodyne interference on 3730KHz, while severe electrical interference was evident on 27MHz. As a result, even routine message handling was intolerably slow. Against this was a continuously increasing need for fast evacuation messages from North Wagga to the Civil Defence headquarters on the city side of the river.

At approximately 10.00pm on Thursday 29 the Wagga District Radio Club net was called in to replace Civil Defence SSB HF on the major traffic handling nets. Continuous traffic was then passed, via WDRC VHF nets between the Warden Post evacuation centre and Civil Defence headquarters. Although the amateurs' message handling procedure was far removed from the official CD procedure, important messages were handled at the rate of two per minute, during the peak of traffic, without any known errors.

The noise free signals between the WDRC VHF operators, when compared with the noises and problems present with the SSB HF signals, impressed many influential people on the scene. When it was realised that the river was to peak in excess of 10 metres, Civil Defence ordered all personnel out of North Wagga, including the WDRC team, minus their vehicle, which was abandoned.

Major activity then switched to the main city side of the river. Many miles of major levee banks surround the entire northern side of the city, with minor banks protecting the eastern and western sectors. With the prospect of a 10 metre or more river height and with the major levee banks, now many years old, designed to withstand only a little over that height, a very serious situation was developing.

A concentrated effort was made by every available service facility in Wagga to raise and generally reinforce all levee banks. As the river rose the main duties of the WDRC VHF operators was to work with the Civil Defence levee patrols and to report problems and requirements as they arose. At one period during Friday night there were five VHF mobiles on patrol with reports going directly to the Civil Defence headquarters.

To go into details of all situations and experiences would take pages to relate. Suffice it to say that the WDRC supplied continuous communication between base and outstations from 10.00pm on Thursday 29th August until 11.00am on Saturday 31st August. By this time the Murrumbidgee river was past its peak and slowly falling. An electricity authority team took over from the WDRC on routine levee patrols and members took a well earned rest, but were still on stand-by.

Because of the above average rainfall in the area during the previous eight months, the water on the flooded country was very slow in running off. As late as Wednesday 4th September, many areas adjacent to the river were still covered.

On Thursday 5th September, with the river still in its swollen state, word was received that a second flood could be expected by the weekend. Expected height was in the region of 9.5 metres.

Once again the WDRC was called in to provide all local Civil Defence communications. Two VHF bases were set up, one at Civil Defence Headquarters Wagga, and one at North Wagga School, plus two river reading posts 10 kilometres and 20 kilometres upstream. In addition to these fixed stations, levee bank patrols in North Wagga were covered by VHF mobiles.

The whole relief operation was centred on saving homes in North Wagga from being inundated for the second time in just over a week. The operation was successful due to the efforts of many volunteers from all sections of the community. This second flood resulted in WDRC operators being on continuous duty from 9.00am of Friday 4th September, until 9.00 am Sunday 6th September, when the river had peaked and was slowly falling.

The WDRC has earned the praise and thanks of the citizens, Civil Defence and other municipal authorities in Wagga for the sterling work done and the service given.

Again the usefulness of amateur radio in the community has been proved. Congratulations to the Wagga District Radio Club.

LOCAL AND OVERSEAS NEWS

REGION I

A piece of Region I news from Des Clift, VK2AHC, relates to the 24GHz band which has been made available to United Kingdom amateurs.

About the end of August, 1974, G3BNL and G3BEZ made a two-way 24GHZ contact over 72 kilometres. This is claimed as a world record. At least 15 to 20 stations are said to be active on that band.

Des, an ex-G operator, mentioned that he has completely re-built to solid state his UHF equipment used in contacts featured in the April, 1974 notes. He is planning to better his achievements on those bands.

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown 2200.

AMATEUR BANDS

Also under construction is a receiver for the 234OMHz OSCAR 7 beacon, scheduled to be launched last month.

REGION II

The following item appeared in the May, 1974 "QST".

Amateurs planning moonbounce arrays will be interested in a research program recently outlined by Dr. Frank D. Drake, professor of astronomy at Cornell University. The program calls for the search of 500 stars nearest the earth for radio emissions indicative of technological civilizations.

"The planned project is under the auspices of NASA at a cost of five thousand million dollars. The final array is to be 16 kilometres long and 92 metres wide, composed of 1400 phased antennas.

"Some rough calculations, if one wished to use the array. (Would'nt we all.) At 432MHz, the gain would be approximately 82dB. If exited by the average amateur moonbounce amplifier the effective radiated power would be 200 thousand million watts. The resulting moonbounce echo, at the antenna, would be 24dBm, or one-quarter watt."

REGION III

Australia: A special general meeting of the NSW division WIA has been called for the 15th November, 1974 at the WI Centre, Crows Nest. The meeting has been called to re-consider the NSW division policy in relation to the WIA 2 metre band plan.

At a special general meeting in April 1973 a motion was passed rejecting the 2 metre band plan which was later adopted by other divisions of the WIA.

RADIO CLUB NEWS

CAMTEC 75

For the 10th successive year, CAMTEC, (formerly Camp Technology), camps will be held during the coming summer.

Sponsored by the Inter-School Christian Fellowship, the camps cater for secondary school students who have an interest in electronics and/or photography.

The camps are held at "The Grange", Mount Victoria, NSW and provide opportunities for beginners and experts to take YRCS courses, operate an amateur station, VK2BCT, construct various electronic projects and to take, develop and print photographs.

Three camps will be held this summer:— CAMTEC Junior — for 1st and 2nd form boys — 18th to 26th January, 1975.

CAMTEC Intermediate — for 3rd and 4th form boys — 7th to 15th January, 1975.

CAMTEC Senior — for 5th and 6th form boys and girls — 27th December, 1974 to 4th January, 1975.

For more information contact Mr J. Wightman, 10/37 Eddystone Road, Bexley, NSW 2207.

Armidale Police Boys' Radio Club

This club has been operating for four years as a section of the Police Citizens Boy's Club in Armidale. During that ,period YRCS classes have been conducted and, in addition to YRCS certificates gained by members, two have gained amateur licences and two more will be sitting for the February 1975 exam.

This year the Police Boy's Club Federation presented the club with a new FT101 transceiver and an all band aerial system. With other equipment donated by the WIA and members, the club's station VK2BAA can operate on all the popular HF and VHF bands.

Trips have been made to the OTC satellite station at Moree, CSIRO solar observatory at Culgoora, TV transmitter at Mt Kaputar, the tidal research centre at Hilgrove and the ionosphere research centre near Armidale.

The annual field day will be held over the holiday weekend 25th-27th January, 1975.

St George Amateur Radio Society

At the September meeting of the St George Amateur Radio Society, at the Rockdale Civil Defence Headquarters, Highgate Street, Bexley, members decided to make the Ceylon Amateur Radio Society a sister club. This move followed a visit to the club by Chanti, 4S7WP who told members of amateur radio activities in his country. Prior to Chanti's departure from Sydney arrangements were made which permitted a gift of radio components to be sent with him for amateurs in Ceylon.

It was also decided at the meeting to make application to install an FM two-metre repeater on the new channel 2 frequencies.

SGARS meetings are held on the first Wednesday of each month. For more details see the Radio Club Directory next month.

Moorabbin & District Radio Club

At the August meeting of the MDRC the latest plan for the proposed brick clubrooms was on display. This plan provides club room facilities for four local sporting clubs, along with kitchen facilities, store

rooms and a large general hall. Provision is also made for a radio mast adjacent to the room to be set aside for the MDRC. The latest estimated cost is $65,000.

At present MDRC meetings are held on the 1st and 3rd Fridays of each month at the Moorabbin Baseball club rooms.

Western Australia VHF Group

Two special committee's have been set up by the WA VHF Group. The first consisting of J. Sullivan, VK6ZFO; W. Howse, VK6ZAA and J. Watson, VK6JW will prepare a master plan for the development of the Wireless Hill Museum. The second consisting of G. Grieve, VK6ZDO; D. Reimann, VK6DY and J. Young, VK6JY are to investigate and report on the amateur activities of the VHF group.

A cleanup of the Wireless Hill building was carried out by six members of the group and an extensive rearrangement of exhibits was also made. A start will now be made on cataloguing the items for display.

Gold Coast Radio Club

It is reported that the power has been connected to the Gold Coast VHF FM repeater site and VK4WIG/R1 should be operating. The frequencies are 146.10MHz receive and 146.70MHz transmit.

Discussions on the proposed affiliation with the Queensland Flotilla 1 of the Australian Volunteer Coast Guard Association were nearly complete when these notes were being compiled. This is an instance of amateur radio assisting a community service.

Central Coast Amateur Radio Club

Late in August the committee conducted a survey aimed at improving the central coast repeater coverage. A station was set up adjacent to the Mangrove Trig point, at Somersby, receiving on 145.6MHz and transmitting on 145.85MHz. It was set to transmit continuous carrier when not in use and to transmit its call sign every five minutes. Six mobile units then travelled around the central coast area and beyond, comparing signals through the repeater.

The survey report was presented in the form of areas where the average signal was superior to that from the present site at Kariong:

"The Somersby site was far superior in most areas. In most areas where the signal from Kariong was stronger, a signal of usable strength was still available from Somersby. The Somersby signal effectively penetrates Patonga; Hornsby to Berowra; Spencer; parts of Mangrove Mountain; North Kulnura; Bumble; Yarramalong Valley and much of the Sydney North Shore.

"The worst weak signal areas from Somersby appear to be Copacabana; Woy Woy to Point Clare; West Gosford to Kariong and the Pacific Highway through Mooney. However, the weaker signal in these areas is far outweighed by the dramatic improvement offered in so many other areas."

No recommendation was quoted whether the site should be changed.

Plans are already under way to make the 1975 CCRC field day on the 23rd February the biggest yet.

University of NSW Amateur Radio Society

The Society has formed a low power slow Morse and voice net on 27.125MHz to determine the requirements and problems which the new novice licensee may face. Several amateurs in the Sydney "QRP-QRS-CW-AM-11 metre-net" using 3 watt and 700 milliwatt units have had contacts over 80 kilometres to Wollongong, Blue Mountains, and Gosford on phone and CW.

It is thought that the 11 metre band will become the most popular band for the novice licensee because of the plentiful supply of inexpensive equipment.

UNSWARS may be contacted by writing to — The Union Box 57, P.O. Box 1, Kensington, NSW 2033.

WIA YOUTH RADIO SCHEME

At the time these notes were being compiled no official details of the discussions or decisions of the YRCS state supervisors conference held at Maitland in September 1974, had been received. However, some details of an extraordinary general meeting of NSW YRCS club leaders held on the 25th August, 1974 was to hand.

Seventeen club leaders and observers were present. The meeting was convened to meet the wishes of club leaders and others who had not been given an opportunity to present a collective NSW YRCS opinion on matters they wanted presented to the meeting of YRCS state supervisors.

As the result of three hours discussion and unanimous decisions a long list of submissions and directives were formulated for the NSW state supervisor to present to the state supervisors conference.

A number of important points relating to the revised syllabuses — prepared by the Federal YRCS Syllabus Revision Committee under the chairmanship of Mr Rex Black, VK2YA — were discussed and recommendations passed to the NSW supervisor for presentation at the Maitland meeting.

The most important topic considered was devising a constitution for the YRCS in NSW. Such a document was considered necessary to give guidelines to YRCS work and activities. A constitution committee was elected comprising Steve Blair (University NSW Amateur Radio Society); Noel Ericsson and George Darouti (St George YRCS Training Annexe) and Rex Black (Blue Mts Branch and founder of the YRCS). The committee is to prepare a draft constitution and circulate it to all clubs for comment and suggestions, following which a further draft will be considered by an extraordinary meeting of club leaders for final approval.

The constitution will be passed to the NSW divisional council of the WIA for legal vetting and ratification. After ratification it will be possible to elect office bearers, a management committee, and embark on a wide range of progressive activities not possible at present due to lack of adequate guidelines.

It is understood that the first draft had been completed and was under consideration when these notes were written.

South Australia

Unfortunately a letter, dated July, from Allen Dunn, VK5FD, YRCS state supervisor for South Australia, seems to have experienced more than its share of mail delay. It gave details of a YRCS display organised in an Adelaide city store during the August/September school vacation.

Also mentioned was the annual general meeting of the club leaders in South Australia, when draft copies of the revised YRSC syllabuses were reviewed. The president of the WIA S. Aust. division Les Diener, VK5NJ, outlined plans for a YRCS club at the division's headquarters.

Notes on the Port Augusta, Port Pirie, St Mary's and Sacred Heart Youth Radio Clubs were also included.

On 17th July 1974, before a school assembly of over 1000 students, Mr P. Hutchins VK5PH, on behalf of the Institution of Radio and Electronic Engineers, presented the Sacred Heart College YRC with the IREE pennant for achievement of being the most progressive school club in South Australia during 1973. A point of interest mentioned at the ceremony was that in 1923 one of the monks at the college had operated a 10 watt transmitter.

A senior student and club president, John Canny received the pennant on behalf of the club.

St George YRCS Training Annex

The St George YRCS Training Annex is run by Noel Ericsson, VK2MF, at 17 McIntyre Avenue Brighton Le Sands, NSW. Patrons are Mr Doug McClelland MHR Minister for the Media, Mr Len Reynolds MLA for Barton and Mr Rex Black, VK2YA founder of the YRCS.

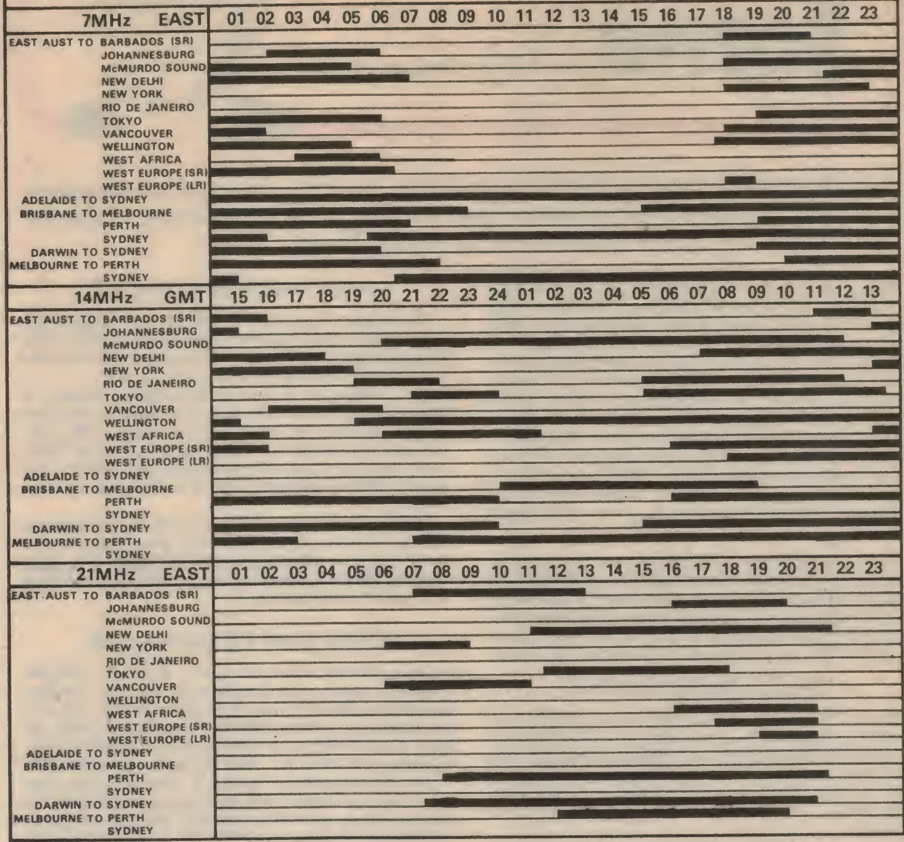
Classes are held under qualified instructors using modern training techniques. A special trainer is used to teach the morse code and audio/visual lectures are presented. Construction kits of radio projects, made available by members of the radio trade, enable students to grasp the basic theory fundamentals.

During the first eight months of 1974, students have gained YRCS certificates in the Elementary (11); Intermediate (1) and Senior (4) grades. Of these, eight were honour passes. Four students also sat for the AOCP exam in August, and are awaiting the results.

In addition, students are taken on visits to various establishments where the accent is on radio communications.

IONOSPHERIC PREDICTIONS FOR NOVEMBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 11.74



Shortwave Scene

by Arthur Cushen, MBE

This year many shortwave stations have been broadcasting special programs for the handicapped to encourage them to take up radio listening. Included among these are Radio Nederland and Radio Canada.

Radio Nederland's DX Jukebox program, broadcast on Thursday at 0645 and 0815GMT on 11730 and 9715kHz respectively, has pioneered this type of program and has issued a special verification card which is partly in print and partly in Braille. We designed this card for Harry van Gelder, and it has been widely accepted as something unique in verification cards. Radio Nederland has recently broadcast a series of talks on the Handicapped Aid Program, and this included two by the writer on techniques of listening to and reporting stations for the blind listener. Readers can obtain copies of the script of these talks from Radio Nederland, DX Jukebox, PO Box 222, Hilversum, Holland.

Radio Canada has also commenced a series of programs on the same theme, and listeners to the club session will have been made aware of the interest of Ian McFarland in this project. Three talks have been prepared, one on the theme of a blind broadcaster and the other two on aspects of listening for the blind.

CBC RETIMES SERVICE

Radio Canada has retimed its service to the South Pacific, and this is now broadcast from 1000-1100GMT on 5970 and 9625kHz. The previous transmission was from 0830-0930GMT, while the first transmission to New Zealand, which was commenced on July 6, 1947, was of 60 minutes duration every Sunday on 9610 and 11720kHz.

The new broadcasting time will mean a later listening time for New Zealanders, but a more convenient time for the Australian listener. Radio Canada has further advised that the transmission broadcast to the United Kingdom at 2100GMT will also be beamed for reception in the South Pacific.

BRAZILIA ON 11780kHz

Radio Nacional Brazilia, after broadcasting to Europe on 15245kHz, has made a frequency change to 11780kHz. The transmission from 1900-2200GMT remains the same with Portuguese at 1900, German 2000, and English 2100GMT. The station advises that they could make another frequency change in the near future.

Verification by airmail in the form of a card and pennant has been received from Radio Nacional Brazilia. As well as the schedule, the station gave its new mailing address as: Radio Nacional Brazilia, PO Box 07/0175, Brasilia, Federal District, Brazil.

The new frequency of 11780kHz is not a good one as at 2100GMT it is mixed with Radio New Zealand and at 2115GMT the BBC opens on the channel. The station first announced that they would use 11820kHz, but instead have been heard on 11780kHz.

NEW VOA FREQUENCIES

The Voice of America has introduced some new frequencies in its service to Oceania. The transmission from 1100GMT is now carried on 5955 and 9730kHz from Dixon and on 6110kHz from the Philippines. The full transmission is from 1100-1400GMT. For transmissions from 2200-2400GMT VOA is using 9545 and 15290kHz from the Philippines and 17820, 21610kHz from Dixon. Another transmission which is broadcast Monday to Friday from 0130-0200GMT is made up of 30 minutes of special events of interest to listeners in Oceania and Asia. This transmission is now broadcast on 9770, 11805, 15155, 15185, 17705, 17750, 17850, 21570kHz.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

NEW NSB FREQUENCY

The Nippon Shortwave Broadcasting Company in Tokyo is now using the new frequency of 6115kHz for its second program. This channel replaces 7230kHz and went into permanent operation last month.

The Nippon Shortwave Broadcasting Company is Japan's only commercial station to operate on shortwave and has no medium-wave relay. The new frequency of 6115kHz operates from 2300-0720GMT with an extension to 0745GMT on Saturday and Sunday. The power of this transmitter is 10kW and has the call sign JOZ6.

The Far East Network in Tokyo, which also operates a shortwave service for American servicemen is now being heard on 15260kHz around 0615GMT. Two other frequencies give good reception at 1000GMT and these are on 6155 and 3910kHz.

HCJB'S NEW FREQUENCIES

Radio station HCJB at Quito, Ecuador, has introduced some new frequencies for its English broadcasts. The service to the South Pacific which is broadcast from 0715-1045GMT is carried, in part, on three frequencies, as follows: 6130kHz, 0830-1045GMT; 9745kHz, 0715-1045GMT; and 11915kHz, 0500-0830GMT.

Broadcasts to North America have also been observed on new frequencies. The frequency of 5970kHz is now used from 0030-0700GMT, with the same program on 9560kHz. Transmissions to Europe are carried on 6080kHz and 9760kHz, and are received from 0715-0830GMT. The morning transmission from 1900-2030GMT is on 15300 and 17705kHz, while another service from 1730-1800GMT in English is on 15315 and 17705kHz.

KGEI USES 6000kHz

Radio station KGEI at San Francisco has been heard on the new frequency of 6MHz with a program beamed to Latin America. The station carried a broadcast in Spanish up to 0700GMT when it left the frequency and ended its transmissions. Reception on this new channel has been fairly good in New Zealand, though there is some interference from weaker signals on the same frequency.

The station is installing a transmitter of 250kW and some years ago they were assigned some new frequencies by the FCC for tests on the higher power. These channels were 6100, 9510, 11940, 15375 and 17730kHz. KGEI is now owned by the Far East Broadcasting Company, and recently stepped up its transmissions to operate 24 hours a day with programs beamed to Latin America and Asia.

RECENT VERIFICATIONS

VENEZUELA: "Radio Universidad", which has the call sign YVOJ, has been heard operating on 3395kHz around 1015GMT. The address of the station is: Radio "Universidad", Apartado 74, Merida, Venezuela.

PERU: A verification letter has been received from Radio Libertad at Junin, Peru, confirming our reception on 5040kHz. The power of the transmitter is 1kW and the station included with its letter details of the aerial system for its medium and shortwave service. Also enclosed was a first day cover of three stamps issued to commemorate the 150th anniversary of an important battle in Peru, as well as a pamphlet about the stamps. The station's address is: Radio Libertad, Jiron Bolivar 497, Junin, Peru. The letter was signed by the Director General.

COLOMBIA: Radio Nacional at Bogota has been heard opening transmission on 6030kHz at 0930GMT. The station confirmed our reception with one of the most elaborate pennants we have yet received from South America, as well as sending a verification card. According to the card they operate on 4955, 6030, and 9635kHz.

DEUTSCHE WELLE RELAY

Transmissions continue to he heard from the new Malta relay Deutsche Welle, and these are broadcast mainly on a test basis. The latest schedule is as follows:

GMT	kHz	Area
1115-1215	11865, 15235	Japan
1300-1425	21650	Far East
1600-1750	11705, 15275	South Asia
0520-0650	6025	Near East
1430-1510	11785, 15320	Near East
1910-2100	6065	Near East
2105-2130	6065	Near East
1300-1425	15320	North Africa
0440-0515	6065, 7235	Turkey
1800-1900	7160	Turkey
2140-2230	6000	Europe
2300-0110	9610, 11865	South America
0120-0430	6145, 11865	North America

MEDIUM-WAVE NEWS

CANTON ISLAND: Station WXLE on 1385kHz is now under the direct control of the American Armed Forces Service after being operated on contract. According to a letter received by Merv Branks, Invercargill, NZ the station is keen to receive reception reports. There also seems to be some confusion about the identity of the station, as WXLE was the call sign of a station at Eniwitok. Reports should be sent to Max A. Chapman, Radio WXLE, Post Master, San Francisco, 96401. The station operates 24 hours a day and is best received around dusk in New Zealand.

NEW ZEALAND: The repeater station for 1XX Whakatane (located at Murupara) which has been operating on 1240kHz, the same frequency as the Whakatane station, has now moved to 1110kHz. Reception of the 100W transmitter has been possible in various parts of New Zealand at dusk before interference from 2UW Sydney, also on 1110kHz, becomes too severe.

LISTENING BRIEFS EUROPE

PORTUGAL: The Voice of Hope, which uses the transmitters of Trans Europe at Sines, is to retime its service in English. According to the station, the English program is to be combined into a one hour transmission and will be broadcast from 0900-1000GMT as from January. The frequency currently in use is 9670kHz. The new program will be heard on Sunday only.

A new verification card is shortly to be printed and issued to listeners who send correct reports on the Voice of Hope broadcasts.

BELGIUM: The Belgium National Radio has two transmissions in English each day and one of these is beamed to the South Pacific. The English service is carried from 2255-2315GMT and from 0040-0100GMT on 6055 and 9655kHz. The DX session is heard on the 4th Monday of each month, and is compered by Jackie Marshall.

DENMARK: Radio Denmark in Copenhagen, in its service to South America, opens transmission at 2200GMT. Signals on 15165kHz are fair at this time at our location, while Jack Buckley of Coogee NSW reports hearing the station closing at 2245GMT with full identification in English.

FINLAND: Radio Finland at Helsinki has a program in English from 2030-2100GMT, and on Friday this is called "Friday Magazine". The station provides good reception during this period on 15185kHz. According to the closing announcement English programs are again broadcast at 2300GMT.

ASIA

INDONESIA: According to Craig Tyson of Wembley, WA, the Indonesian station on 4089kHz has extended its schedule. The address of this station is: Jalan Semeru NO 40, Blitar, Jatim (Jawa Timur), Indonesia. RPDK Simalungun, on 3510kHz also seems to have extended its schedule which was from 0230-0420GMT, and from 0800-0920GMT. The station is now heard from 1000GMT till sign-off at 1600GMT.

BHUTAN: Radio Sweden advises in its DXers Calling session that Radio N.Y.A.B. will install two new transmitters of 50kW at Thimphu and Phuntsholing. From January 1975 there will be broadcasts from 0030-0330GMT and from 1130-1530GMT in English, Bhutani, Nepali and Hindi. At the present time, the station broadcasts on Sunday only from 0730-0930GMT on 7040kHz with 10kW.

PHILIPPINES: The South East Asia Radio Voice has been heard on a new frequency broadcasting from Manila. This new channel is 9770kHz and the station opens at 1200GMT with a Gospel program in Burmese. It is understood that the call sign is DZU6.

INFORMATION CENTRE

FM, AMATEUR: How is it possible to determine the range of an FM transmitter? How can I become a radio amateur? What books and projects should I obtain to provide a reasonable selection of equipment for such a project? (G.B., Moss Vale, NSW)

The easiest way to determine the range of an FM transmitter (or any transmitter for that matter) is to move away from it until the signals are lost! Quite seriously, this is really the only completely accurate way. A reasonable estimate can be made for VHF (FM) transmissions on the basis that they are generally restricted to the line of sight or the horizon as seen from the transmitting aerial, or a little beyond. Unfortunately, there are so many other factors involved, such as the power of the transmitter, local electrical noise, the kind of signal being handled and the standard of reception required, that it is impossible to set hard and fast rules. When engineers want to know the answer they make field strength measurements.

Amateur licences are issued by the PMG's Department to those applicants who have passed technical, regulations, and Morse code exams (or the technical and regulations only for a limited licence), For further details we suggest you contact the Wireless Institute of Australia, 14 Atchison St, Crows Nest, NSW 2065. See the advertisement elsewhere in this issue. They will provide details of the exam, books to study etc. Regarding equipment we suggest you wait until you have completed your examination. By that time you will be in a much better position to know what you want.

SOLDERLESS CONNECTIONS: I have often seen in your magazine advertisements for kits stating that "no soldering is required". How then are connections made, and how reliable are these connections? Thanks for a good magazine. I particularly like many of your projects. However, I have always wondered why you don't give an indication of how much the projects cost to build. (M.G., Moonee Ponds, Vic.)

The kits to which you refer are generally assembled using pre-wired modules and some form of mechanical interconnection such as wire links fitted with plugs which mate with sockets or pins, or multiple plugs and sockets. Provided they are correctly assembled initially, such connections are usually quite reliable.

We generally do not quote prices for kits as we feel that we are not in the best position to do so. The time spent accurately costing a project would add substantially to the cost of the magazine, and the final estimate would still be subject to changes in the cost and availability of individual components.

If we were to quote a price which was too low, we would leave kit and component dealers open to accusations of overcharging. Conversely, a quoted price which was too high would tend to stifle competition, as the prices of kits would invariably be set at the higher price, to the disadvantage of the individual constructor.

We feel that the best people to quote prices on our kits are those that are actually selling them, the component and kit suppliers who advertise in the magazine.

However, we do not disregard the cost of projects; they are designed to give maximum performance at a reasonable cost, using readily available components.

DEAD LETTER: We are holding a letter addressed to Mr R. Cedock, C/- Molanka Guest House, Todd St, Alice Springs. This has been returned by the postal authorities marked "not at this address". If Mr Cedock will supply his present address we will forward the letter to him.

VALVE TO SOLID STATE? I have in my possession an oscilloscope with a vertical bandwidth of better than 1MHz, and a horizontal bandwidth of 150kHz. Is there a way to increase the bandwidth to better than 30MHz?

Also is there any way to convert a valve circuit into solid state? Where would I obtain technical data on ICs etc.? (G.B., Moss Moss Vale, NSW.)

To increase the bandwidth would require a complete redesign of the relevant circuits, and in all probability would cost more than a new oscilloscope with the required specifications.

Solid state plug in replacements for some types of valves are available. However, in general such conversions are not practical. Technical data on ICs is obtainable from the manufacturers, and also from some component suppliers.

CD IGNITION: I purchased a CDI kit with a prewound T1 secondary from one of the of the suppliers who advertise in your magazine. Included were photocopies of the original text by A. J. Fraser (August 1970, 3/TI/6). The winding was not layer wound and had no interlayer insulation. The wire gauge was 32 B&S instead of the specified 28 B&S. The feedback winding gauge is specified as 26 B&S while the primary is 22 B&S. I was supplied with a small quantity of 26 and 28 B&S for these two windings.

I could not get the matter clarified by the supplier over the telephone. Perhaps you could advise what wire gauges should be used if they are to differ from the text. Will the smaller cross-section secondary tend to overheat? The condenser C3 appears to be of the early type and not the Plessey Ducon oil-filled type. I am at a loss to know what difference it will make to mount the standard ignition coil upside down — refer item 6 last page of your article. This just makes no sense to me. This has nothing to do with a spark plug lead coming off a plug. (R.A., Castlecrag, NSW).

As noted in the Errata published in September 1970, the author advised that the wire gauges which should be used in the inverter transformer are 26, 28 and 32 B&S. The secondary winding is scramble wound, ie, no interlayer insulation and not layer wound. For maximum reliability, the discharge capacitor should be an oil-filled type such as Ducon 5S10A. The coil is inverted to ensure that oil covers the top section of the winding, which has the greatest potential difference applied across it. Thus it reduces the possibility of coil breakdown.

ORGANS: Could you tell me in which issues you printed the projects, "Sound Effects for Your Organ". I am building a monophonic organ and would like to know the resistance for each key on a 25 note keyboard. (G.B. Greenborough, Vic.)

The Sound Effects Synthesiser For Organs appeared in October, November and December 1971 (File Nos. 1/EM/25-26-27). Reprints cost 80c each. We cannot help in regard to the resistance values, since we are not familiar with the rest of the circuit. In any case, queries like this are outside the scope of the Information Service. Our own Monophonic Organ was described in December 1967. (File No 1/EM/17). This may provide a starting point.

TELEPHONE EXCHANGE: Thank you for your article on the Automatic Telephone in the July issue. The article mentions possible variations of the basic design and possible expansion to 22 phones. I would appreciate this additional material being published. (D.S. Carnarvon, WA.)

Thank you for the comments, D.S. Presentation of the additional material depends largely on the reaction to the original; if enough people express an interest we will be happy to present it.

SCOPE SWITCH: Thank you for describing the Electronic Scope Switch. you intend to describe a triggered sweep control in the near future? (J.P., Coopers Plains, Q.)

Thank you for your favourable comments. At this stage we do not have any plans to publish a triggered sweep circuit, but we will keep it in mind for the future.

VOLTAGE RATINGS: I have a problem for which I have been given no satisfactory answer: voltage working values for capacitors. I have been told that for electrolytic capacitors, the exact voltage must be used as stated, eg, if a 4.7uF / 16VW electrolytic is required, then a 4.7uF 25VW type cannot be used; only one with a 16VW rating. On the other hand, for ordinary capacitors, types with a voltage rating above that specified can be used, eg, if a 100pF 30VW capacitor is required, you can use a 100pF 100VW capacitor. How true are both of these statements (I am building the Playmaster 142 amplifier) as everyone that I ask seems to give conflicting answers, especially with regard to electrolytic capacitors? (F.B., Guildford, NSW).

Electrolytic capacitors made in recent years, in contrast with earlier types, can be used at DC voltages considerably below their rating. For example, a 25VW electrolytic capacitor may be used in a circuit where only 2 volts DC is impressed across it. In practice, when we specify a capacitor, we try to list those types which are in plentiful supply. But as long as the voltage across a capacitor is less than its rating there is no problem unless a particular capacitor has been specified for the job. In this latter case, mention will be made in the text.

TAPE-OUTPUT AND HEADPHONES: In the June and July issues of your magazine you described the construction of the "Playmaster 141" and the "Playmaster 142," both having provision for tape-output and headphones. Could these provisions be modified to suit the "Playmaster 137" as published in the March 1973 issue? Would any of the associated resistors and trimpots need to be altered in value?

I hope that you can help me as I have been trying to record onto my tape recorder for the past year, using different methods that have all failed.

Thank you for an excellent magazine — so good in fact, that it often distracts me from my homework. (P.R.M., Lane Cove, NSW).

Thank you for your compliment — we trust that even though you may not learn your homework, you learn from reading E.A.!

The provisions for tape-output and headphones can be used with the "Playmaster 137" without modification to any of the resistors and trimpots. But care must be taken not to introduce any extraneous earth loops or earth connections, as these may cause instability and introduce hum.

HIGH FREQUENCY INTERFERENCE: I have just completed building a microphone mixer based on the input circuitry of your 30W PA amplifier of December 1970, using three microphone channels and one auxiliary channel and using the circuitry to the output of TR5.

I have two questions:—

(1) The mixer seems to be rather good at detecting 70MHz (taxi) and 27MHz signals; any suggestions to cure this?

(2) The gain of the system with AGC off is higher than with it on; would increasng the value of the 150kohm resistor feeding the switch equalise this? (D.P.S., Carnarvon, WA.)

The problem of RFI breakthrough can be very tricky, and may require several approaches. The signals may be entering via the speaker leads, and in this case the recommended cure is as outlined in the article on page 64 of the June 1974 issue. (File No 2/LF/7).

If the signals are entering via the input leads, try fitting 0.01uF disc ceramic capacitors between from the earthy side of the input sockets directly to chassis, and 1000pF disc ceramics from base to emitter of transistors TR1 and TR2.

Disc ceramic capacitors must be used, as these have minimum series inductance. Keep all capacitor leads as short as possible to minimise inductance.

Small ferrite beads may also be used as RF chokes. Use FX1115 type beads, or similar, and wind five turns of enamelled copper wire through them. The com-

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If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Actual size dyeline transparencies: $2 each. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Only as available. Within last 6 months, face value. 7-12 months, add 5c surcharge; 13 months or older, add 10c surcharge. Post and packing 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia" Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

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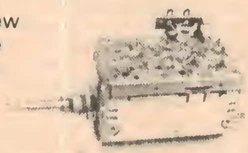
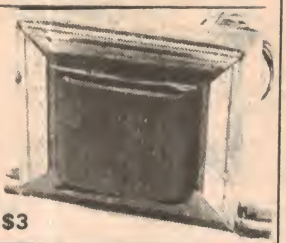


Switch 5 Pos 1 Toggle 240/V **50 cents**.



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Portable 4 speed record player 240 volts all transistor **$19.50**. Pack and post **$1**, interstate **$1.50**.

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Car Radio Push Button Tuner
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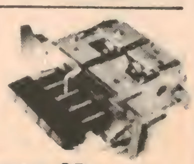

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3 position **50 cents**

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Speaker transformers 7000 to 15 Ohm 3½ watt **$1.25**.

100 mixed condensors micas polyester ceramic fresh stock **$2** per pack and post 25c.

Perspex tops for record players size 12 x 9⅜ x 3¼ **$1.50**.

50/Ohm pots ideal for ext. speakers etc **50c**.

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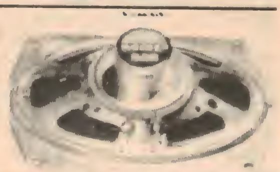

MSP 6½" Speakers
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BSR Ceramic Cartridge Stereo **$4**.

250 mixed screws. BA, Whit, self-tapper bolts, nuts, etc. **$1** bag plus **25c** post.

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25 mixed 5 and 10 Watt resistors **$2.00**.

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Amplifiers 5 x 3, 5 x 1½, 5 x 2½, 6 Volt complete ideal for record players also preamp stage included **$5**

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Stereo Speaker Wire **12 cents** yard

Speakers 8 WR Magnavox 15 OHM **$9**

CURLED EXPANDER WIRE 20FT. **$1.50**

Shielded microphone cable **30cents** Yard

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Speaker transformers 7000 at 3.5 OHM **$1.25**.

Electros 3 in one 100-25-40, 24-250-300, 50-250-300 **75 cents**

Electros 100 MFD 400 Volt **$1.00**.

Speaker transformers 12,000 to 15ohm **$1.25**.

pleted chokes are soldered in series with the input leads, immediately after the input sockets.

With regard to the problem of differing gains when the AGC is on and off, this is normal for the amplifier. (See specifications). Increasing the value of the 150kohm resistor would equalise the gains. The value would have to be determined experimentally.

ORGAN: Recently I have been interested in building an electronic organ, but on a smaller scale to that shown in the July EA. I have seen Hammond organs for just under $600 and was hoping for something no more than $200. Do you know of any supplier of kits such as these? (G.K. Higgins, ACT).

Frankly, we don't like your chances of finding an organ kit for around $200. When you consider the complexity of even a very simple organ, such a figure seems quite unrealistic.

DEAD LETTER: We are holding a letter from Mr Peter Martin, which does not carry any return address. If Mr Martin will supply this information we will answer his letter directly.

FISH FINDER CIRCUIT: Could you please publish in your magazine a fish finder circuit, or if a fish finder circuit is not possible, could you publish a circuit for a battery tester. (Z.S., Richmond, Vic.)

We have no plans at present to publish a fish finder circuit, although the depth sounder featured in the December 1973 issue could be used to locate schools of fish. We have already published a circuit for a battery tester — this appeared in the July 1972 issue (File No. 7/M/41).

FM TUNER: Congratulations on a very informative magazine. Has "Electronics Australia" ever published a project for an AM / FM tuner for use in conjunction with stereo equipment? If not, when were the latest projects on AM and FM tuners published? Is it at all possible to convert an AM tuner to FM operation? Have you any ideas for a shut-off circuit between a turntable and amplifier that will automatically turn off the amplifier when the turntable shuts off? (P.M., Wellington, NSW)

The last FM tuner we published was in January 1957. It is doubtful whether you could even buy the valves for it now, let alone any of the other parts. We have published quite a few wideband AM tuners, the last in January 1974 (File 2/TU/38). While it may be possible to convert some parts of an AM tuner to work in an FM tuner circuit it is doubtful whether it would be worth the trouble. We may be able to describe FM tuner projects shortly,.

If your turntable already has automatic shut-off, then it should be possible to rig its contacts to turn the amplifier off also. All you need is an SPST switch. In one position of the switch the amplifier is normally powered from the mains. In the other position, the amplifier draws its power via the turntable contacts. When the turntable shuts off, so does the amplifier.

NOTES & ERRATA

CRYSTAL LOCKED MUSICAL TONE GENERATOR (August 1974, File No 1/EM/33)

In the diagram on page 74, the labelling of pins 8 and 11 of the 7400 IC should be interchanged. Similarly, the labelling of pins 9 and 10 should be interchanged. However, these are only labelling errors, and the unit will work with either arrangement.

In the same diagram, the labelling of pins 5 and 10 of both 7493 devices must be interchanged. The printed board pattern shown on page 75 is correct.

Note also that the 10k resistor mentioned in the previous erratum (Oct. 1974), has not been shown in the diagram on page 74. It should be shown connecting between pin 14 of the left hand 7493 and the +5V rail.

MINISPOT (June 74): The printed circuit board used in this project was incorrectly quoted as 72/g7. The board used was 70/g2.

PLAYMASTER 143 STEREO AMPLIFIER (September 1974, File No. 1/SA/52. In the diagram on page 49, a printing error has resulted in the omitting of the coding letter "C" from the 15-pair tag strip. The tag labelled "F" should also be labelled "C".

Marketplace

FOR SALE

INTEGRATED CIRCUITS 7400, 7404, 60c; 7490, 7491, 7473, 7474, NE555 $1.75; uA741 $1.00; EM404 10 for $2.50; unmarked uA709 50c; relays, min. 12V 4c / o with base $1.25; computer boards 50c & $1.00; bundles hook-up wire 100ft 50c; post & packing 20c. Burnlee Trading, P.O. Langwarrin, 3910, Vic.

FERROGRAPH MODEL 4A tape recorder, two track; 3-3/4 — 7-1/2 IPS; 7in reel. Very little used, in excellent condition. $80.00. J. W. Borgelt, Esk St, Crows Nest, Qld 4355. Phone 163.

TO CLEAR $1 PACKS: 3xTV IF's w / 3 transistors; 4x comp. bds; 2x uA709; 30x 160V poly caps .001 -.018; SN7400 / 02 / 04 / 10 (any 2); 30x 1/2W E12 resistors; a Marriot 1/2T stereo erase hd; 50x untest. 1/4W zeners or PNP sil / ger trans or ger. diodes; AD161 / 162 $2 pr; 400V 6A triac $1.80. Surtran, Box 317 GPO Sydney 2001.

LAFAYETTE HA-600 Comm. Receiver in box with manual. Only 3 months old, in as brand new condition and excellent performer. Urgently require cash. $185 or nearest offer. Phone 868-201 or M. Stevenson, "Attunga", RMB 59, Harden 2587, NSW.

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ELECTRONIC ORGANS

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MONSTER BARGAIN SALE at **MICRONICS. SUPER BARGAIN SPECIALS** at incredible prices. Satisfaction Guaranteed. **SAVE MONEY. HURRY!** Many have been disappointed when they missed out on some of our **SPECIALS. ORDER NOW!** This month's super special TD772 Silicon. Double diode ideal for making up "AND" Gates — 20 for $1. (Sellout) Flag Heat Sinks — 10 for 40c. Car Radio Push-button Tuners, complete (suit homodyne) — only $2 ea. Min. Tuning Capacitor suitable small I.C. Radio — 2 for $1.50. Larger Tuning Cap. 2 gang — $1.25, 3 gang — $1.75, Slide switches (18 pin) -4 for $1. Power switches, 4 pos. push-button exc. qual. — 2 for $1, **MICRO** switches 250v, 10A — 2 for $1. Preset Pots 250k — 10 for 80c. Miniature Coils Osc. and I.F. mixed, unmarked — 20 for $1.50. Power Resistors, Top Quality, High Stability — 6k, 4.7k, 5.6k (7w), 6.8k (6w), 15k (4w), — 10 for $1. **TRIACS** 40485 (R.C.A.) — 3 for $1 (Sell out). **POLYESTER CAPS** Philips Tubular 400v .001, .0047, .033uf — any 20 for $1. Green Cap + 10pc luf / 200v — 10 for $2.50. **ELECTROLYTICS** Can type 60uf / 200v — 4 for $1. **ZENER DIODES** — 400mv, 4.7v — 10 for $2. **THERMISTORS** 4ohm, 10pc, 25 c — 10 for 80c. **COPPER CLAD BOARDS** 6" x 9" — 4 for $2, 6" x 12" — ? for $2. **FERRIC** Chloride Etchant (Solid) 100 grm bag — 40c.

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CLOSING DATE is six weeks prior to the on-sale date. Issues are on-sale the first Monday of each month.

ADDRESS all classified orders, copy, enquiries, etc. to: The Advertising Manager, ELECTRONICS Australia, Box 162, Beaconsfield, 2014

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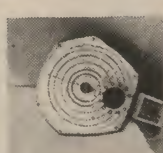

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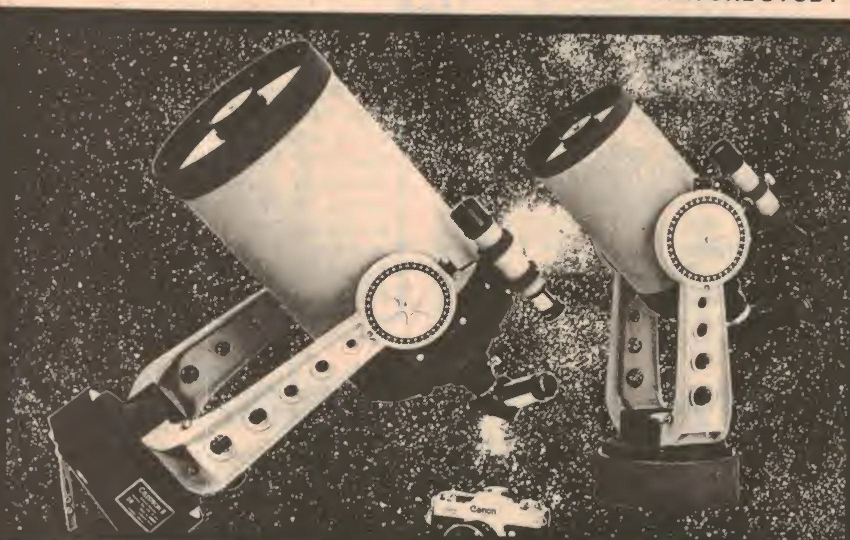

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POWER SUPPLY EX COMPUTER. Fully Transistor Regulated. As new and in perfect working order. 240v AC. Primary 30v P.C. Secondary at 5 amps. $35 each. Freight forward.

COMPUTER TAPE ½" Diameter on 10½" reels in plastic boxes. $1 each P/P $1.

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$26.00
(2 TELEPHONE SETS)

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Producermatic 2" professional endless cartridge replay machines 2 track stereo with third cue track for machine coontrol (auto-stop etc.). 600 OHM line level outputs. 240V AC operation. All silicone transistors 7½ I.P.S. 19" rack mounting. 60Hz (240V) Model $65; 50Hz (240V) Model $90. Ideal for tape idents, background music, etc. $1 cartage to rail. Freight payable at nearest attended railway station.

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1 mile twin(2 miles) genuine ex-Army Don 8 perfect condition $35 per drum $1 cartage to rail freight payable at destination.

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Genuine ex-army Mk 3, liquid damped, as new **$29.50** P & P $1.05.

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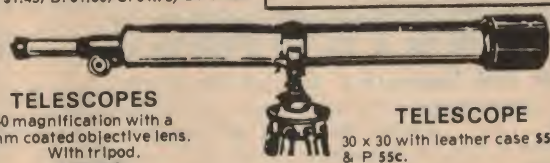

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$35.00
As illustrated.
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3in x 2in containing 2 valves, qty of resistors, etc.
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2½in DIAM. 2in FL. $1.50 each. Or $2.50 per pair. P & P 20c.

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POSTAGE KEY:

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BRAND NEW
IN CARTONS

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65N7GT	95c	1H6G	75c
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5" CRO TUBE

5 BP1 $5.50 each.
Post. A 85c, B $1.10, C $1.25, D $1.35.

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Five sizes: ⅝ inch, ¾ inch, ⅞ inch 1 inch and 1⅛ inches. With taper reamer. **$13.95**
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No. 19 TWO-WAY RADIOS.
Power supply, accessories, etc., $35.

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P.M.G. 200Ohms — 1'500Ohm Coils $2.50 each. P & P 30c.

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SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.95. We haven't got time to sort them, so you reap the benefit.
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plugs into 240V power and gives both 6V and 12V DC output. 4 amps with hi, medium and low charges. Dimensions, 9" x 5" x 5" $45 value only
$32.50
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¼" x 1200' on 7" reels. **$2.50**
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$2.50 P & P 20c
200 MA 24 volt, ⅛in push movement.
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No C45 set, 23 to 38 MHz complete with mast, headphones, mic 24V power supply etc. $95.00.
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A.W.A. SIG GENERATOR

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TRANSPONDER APX6

with Lighthouse Tubes. Can be converted to 1200 MHz. **$17**

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